AMERICAN ENGINEER AND RAILROAD JOURNAL.

DECEMBER, 1900.

CONTENTS.

ANOTHER IMPROVEMENT IN STAYBOLTS.

Mr. J. B. Barnes, Superintendent of Motive Power of the Wabash Railroad, has for a long time been at work upon the development of a staybolt to meet the difficulties found in locomotive boiler practice, which do not appear to have been overcome by any attempts thus far made in the improvement of material or in slight changes in the form of the ordinary staybolt. He aims to relieve the staybolts from being strained to the breaking point and to provide for all the movements of sheets relative to each other in such a way as to leave only the tensile strains for the staybolts to carry. He goes a step beyond the ball and socket idea in that he provides for movements of the sheets toward each other. He uses the ball and socket to give flexibility, but provides for a movement of the ball away from its socket. The construction is such as to permit of application to any part of the firebox and to allow of the removal of the bolt itself, in case of repairs, without disturbing the outside cup which forms a permanent attachment to the outside sheet. Mr. Barnes has in mind the stresses in the sheets as well as the staybolts, and he desires to save the expense caused by the failures of both. That of renewing a single staybolt he finds to vary, all things considered, from 30 cents to $10, depending upon the accessibility. His experience appears to show that he has a staybolt which will not break, at least the records of considerable service fail to show a single one broken.

The design is illustrated in the accompanying engravings. The cup is made from bar steel, or it may be drop forged, and screwed into the outer sheet. While it is best to have this cup exactly radial, or in line with the inside hole, it is not imperative that it should be so, as the ball joint under the head of the bolt and the taper hole in the base of the cup will allow considerable more variation than is required for the expansion movements of the sheets. After the cup is screwed into the outside sheet the staybolt is entered and screwed into the inside sheet by means of the square socket tool. A holding-on bar is used on the head of the bolt, while the firebox end is being headed over. The taper plug is then inserted and not only prevents leakage that may escape past the ball joint but tends to spread the cup in the outer sheet and insure a steam tight and rigid joint between the cup and the sheet. If, from any cause it is necessary to remove the bolt, the plug can be screwed out, the inside end of the staybolt chipped or drilled and the bolt removed, leaving the cup intact in the outer sheet. These bolts can be made flush with the outside sheet and be placed behind brackets, expansion plates, air pumps and other inaccessible places.

Ordinarily the custom with the common form of staybolt to offset its weaknesses is to use from 75 to 250 extra bolts to each boiler, these bolts being reinforcements to the ones equally spaced and located at the ends, top corners and back end of the firebox. With the bolt shown no reinforcement is necessary, as no provision is made for broken bolts. Using this design also for radial stays insures the free movement of the crown sheet without cramping the stays or cracking the flue sheet. With the use of this bolt the need for drilled or hollow bolts no longer exists. The staybolt nuisance, according to this experience, may be practically overcome by replacing all broken bolts with the new design or by using the flexible bolts in nests at each top corner of the firebox in the two vertical rows at each end of the firebox and the outside row around the door sheet.

These and other designs of flexible staybolts are sometimes criticised on account of the large holes in the outer sheet. Such criticism might apply were it not for the fact that each staybolt in a firebox forms a separate and distinct brace for the sheets and the pressure upon the firebox sheets transmitted through the staybolts will guard the tensile, as well as the bulging strains, on the outside sheet. Were this not the case how could we reconcile our minds to the single-riveted seams frequently used in the wagon top sheets and back heads. The mere fact that flexible staybolts, requiring these large holes in the outer sheets, have been in use for years with no bad results to the boiler shell would go to prove that the critics' position is untenable.

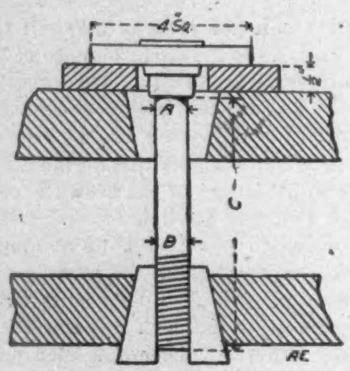
Mr. Barnes has also kindly sent us the records of the destructive tests of three staybolts of this design, the appearance of one of which, both before and after the test, being illustrated in the accompanying wood engraving which was made direct from specimen No. 1, referred to in the record. The tests were made at Purdue University under the direction of Prof. Goss and certified to by Prof. W. K. Hatt. They show an ample margin of strength, and it is interesting to note that the cup, bolt and head are nearly co-equal in strength, a result which must always be pleasing to a designer. Mr. Barnes has a great many of these bolts in use in boilers carrying high pressures as well as others. They are used in all boilers to replace broken ones of the ordinary kind, and there has been no trouble in breakage or leakage, nor has there been any expense for repairs in connection with them. The report by Prof. Goss follows, and it should be noted that the body of the bolt was strained up to its elastic limit before failure occurred.

The plate attached to the flexible joint was supported on the upper end and the threaded end of the bolt was gripped in the wedges of a 50,000-lb. Riehle hydraulic machine, as shown in the sketch. Load in tension was gradually applied until failure occurred. Failure occurred in all cases by the enlarged head of the bolt pulling out from its seat. The results were as shown on page 366.

No. of Bolt.	First Slip.	Maximum Load.	Failure.	Remarks.
1	29,000 lbs.	31,100 lbs.	Head Pulled Out.	....
2	7,800 "	27,800 "	"	At 27,000 lbs. bolt began to scale at yield point near wedge.
	31,850 "	31,850 "	"	At 31,000 lbs. bolt began to scale at yield point near wedge.

Dimensions Corresponding with Sketch.

	No. 1.	No. 2.	No. 3.
A	1.08 inches.	1.078 inches.	1.108 inches.
B	0.912 "	1.008 "	1.065 "
C	6.35 "	6.35 "	6.50 "



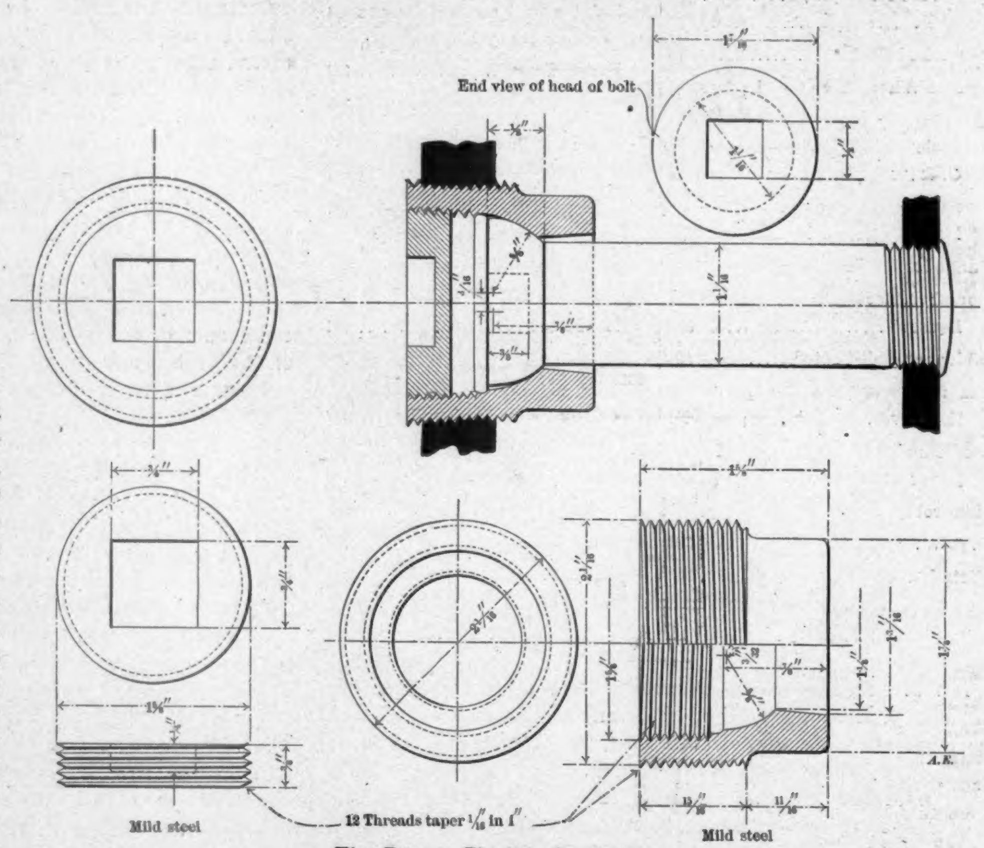
Method of Testing.

In the new conditions brought about by the recent and present unprecedented demands for power, round-house practice has become more important than ever before and the staybolt problem appears as one of the serious difficulties in securing the best use of engines because of the delays caused by it in "turning" locomotives. From this standpoint much may be said. We are now in an age of pooled engines, shortage of power and temptations are strong to depart from the rules which good judgment and safety demand. The staybolt inherited from the earliest locomotives is expected to meet conditions which are entirely new and were never thought of before.

Inspectors who are sure to detect broken staybolts by the hammer test, to put it mildly, are rare, and it is generally believed that the drilling or hollow construction of staybolts meets this difficulty, but even the drilled or hollow staybolts fail at times to indicate when they are broken. It is not unusual to find drilled staybolts broken with no outward sign of fracture. This may be caused by the holes becoming clogged with rust and dirt from the outside or the fractures may be closed up with scale from the water inside. An insight into the roundhouse part of the staybolt question may be had by granting that tell-tale holes will do what they are supposed to do and looking for a moment into the routine of the work of the round-house foreman at a busy terminal.

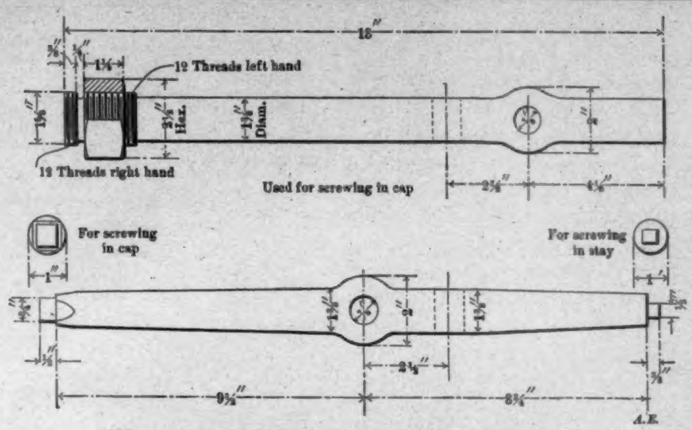
The conditions upon his arrival for the day are discouraging. He is required to accomplish almost impossible tasks with poor facilities. He finds upon his desk the work book, letters and telegrams, recording many troubles. One engine lost time on a passenger train because of foaming. The question is asked why the boiler was not washed out, with an allowance of two hours between arrival and departure from the round-house? Another engine gave up its train because of staybolts and flues leaking. The trainmaster orders an engine to be ready at 8:30 a. m. It is now 7:15 and two broken staybolts are reported on the work book. The boilermaker then reports that another engine, which must be ready in an hour, has three broken staybolts and is squirting water from the holes. No other engines are available, and it is a serious matter to delay this particular train. What is to be done? Simply what is being done every day in the year and on every railroad. The broken staybolts are pened over with the hammer, which stops the leakage, and the proper repairs are deferred until the next trip, when the condition is worse than before, because the broken bolts throw their loads upon their neighbors.

We are forced to the conclusion that compliance with the rules requiring each and every broken staybolt to be renewed immediately would cause a blockade. Nothing more than this is needed to show the advisability of improving staybolts so that they will not break. Those who are in position to know say that this can be and is being done.

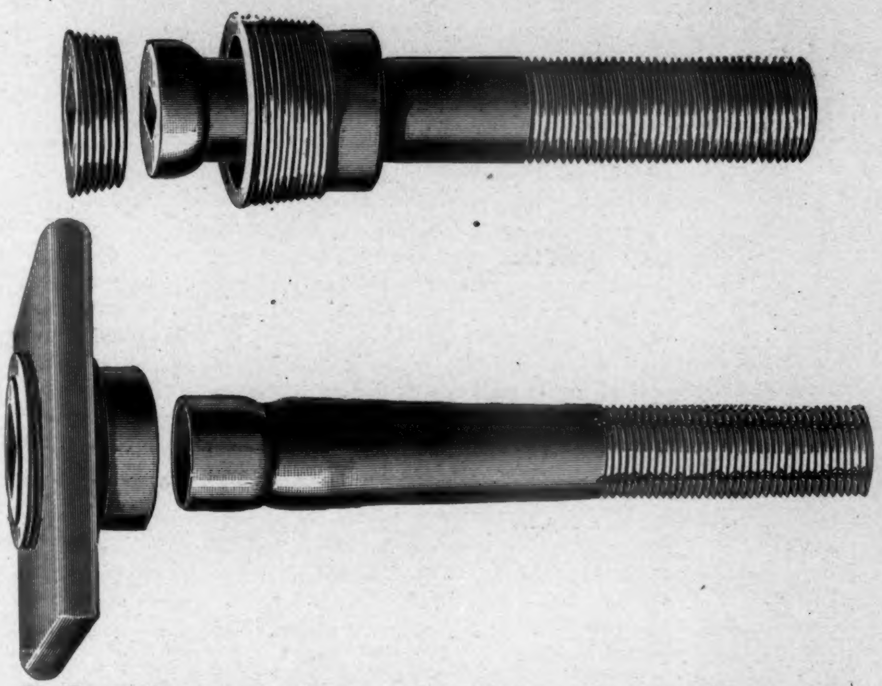


The Barnes Flexible Staybolt.

Mr. Waldo H. Marshall, Superintendent of Motive Power of the Lake Shore & Michigan Southern Railway, gave the second in the series of lectures in the railway course at Purdue University on Thursday, November 1st. His subject was "Locomotive Design." Mr. Marshall first discussed the conditions which control the selection of a type of locomotive which is to render a given service. He urged the importance of making machinery light so that all available weight may be put into the boiler. The possibility of improving present designs by the adoption of steel for wrought and cast iron was carefully reviewed, and examples were given of recent achievements in this direction. In a similar manner, other problems of design which are general in their application, but which readily resolve themselves into matters of detail, were forcefully discussed. Comment upon his remarks concerning care in the design of details to give a handsome appearance to the locomotive and its worthiness of such treatment will be found elsewhere in this issue.



Wrenches for Screwing in Cups and Staybolts.



The Barnes Staybolt—Showing Construction and the Effect of a Destructive Test.

The armor plate difficulty between the Navy Department and the manufacturers has at last been settled. It is reported that the Carnegie and Bethlehem companies have reduced the price of Krupp armor plate to $420 per ton. This will affect 14 vessels and the contracts now standing will involve about $14,000,000.

The embarrassment caused by the shortage of freight equipment, particularly freight cars, appears to be growing worse instead of better. Ever since the car famine struck the Northwest it has steadily been spreading out in all directions until now it affects the whole country. Many remedies have been suggested, but the railroads have not been able to hit on any one plan. The roads have been enlarging their equipment both in number of cars and in capacity, but the periodical demands for rolling stock to take care of the available business is more than they can keep pace with. The question of sidetracking the excess rolling stock in times of decreased traffic is also one to be considered by the railroads, as this means a loss during the time of idleness, besides deterioration of equipment. The demand is at present being met in a way, by loading the cars to their utmost capacity, but in no case is excess loading permitted.

The Central Railroad of New Jersey has begun improvements at its Jersey City terminal which will cost about $100,000. They are in the form of increased facilities.

WHAT MOTIVE POWER OFFICERS CONSIDER IMPORTANT.

(Continued from page 337.)

Lubrication methods are now given more attention than ever before. It is a serious matter to delay traffic by hot bearings, and with conditions which cause the trouble increasing in severity, as they are, the subject is worthy of all the thought that is given to it. The article in our October number upon lubrication from the standpoint of fluid pressures has attracted a great deal of attention. It will, undoubtedly, lead to experiments on a number of roads with oil grooves in the sides of driving boxes, and the closing up of the oil holes and cavities in the tops of the bearings. The lubrication question was brought up in nearly every interview and was mentioned oftener than any other subject.

Flanges on all driving wheels of locomotives of all classes seems to be the rule almost everywhere. Flanges were omitted originally in order to reduce curve resistance and avoid the cutting of tires, but these are really made much worse by throwing all of the grinding upon a smaller number of flanges, which is just what the blind tires do. But when the wheels are all flanged something must be done to give the necessary lateral motion to allow for the effects of curvature. This is done in various ways, by setting the tires in toward the center of the track, making the gauge of the central wheels of 10-wheel or consolidation engines narrower than the standard, by setting the tires to the standard distance and paring down the flanges where they bear against the rail or by setting the tires of the middle wheels at somewhat less than the standard distance and leaving them standard as to contour but giving the wheels sufficient lateral play to accomplish the same result as the other methods. On the Lehigh Valley ⅝ in. lateral play is allowed. On engines of about 15 ft. wheel base the tires of the middle wheels are set 53¼ ins. This, with the amount of lateral play mentioned, appears to solve the difficulty. No flanges are cut, the engines curve easily and the driving wheels do not bend or cut their hubs. If, however, with the other conditions, as stated, the lateral play is confined to ⅛ in. on each side or ¼ in. total, the entire ⅝ in. clearance will be taken by the engine in the form of cutting and grinding in a single trip from Easton to Wilkesbarre.

A system of indexing and filing important articles on motive power subjects was found in three different drafting rooms. In one of them, the Buffalo, Rochester & Pittsburgh, where new shop plans are under discussion, was found an abstract of all of the descriptions and discussions of the arrangement of shops which have appeared in the leading railroad papers for several years. It was condensed to the last degree and covered the principles of modern shop arrangement in a most convenient form. The chief and only wide difference of opinion seemed to be with reference to the location of the tracks, whether transverse or longitudinal, a question which is by no means settled. The indexing referred to consisted in placing upon cards, alphabetically arranged, titles and notes whereby important articles may be easily found and their character noted beforehand. Railroad technical periodicals are thus made easily available and their value as a permant record increased. This practice is worthy of encouragement and development, for such an index may be made an important labor-saving device.

On many roads it is customary to supply each engineer with

an individual set of oil cans, with a view of easily keeping account of the oil consumed. As the number of engineers is usually greater than the number of engines, a large number of cans are required. Mr. G. R. Henderson, of the Chicago & Northwestern, has recently put into practice a simple plan which seems to be a great improvement upon the one referred to. Oil cans enough for all engines are furnished and when an engineer reports for duty he receives full cans which he takes to the engine. Upon his return the cans are again filled and he is charged with the amount of oil required to fill them. This method releases a large number of cans which are held in the storehouse until needed for replacement. With this plan the engineers are not bothered to store their own cans and by using a smaller number it becomes easier and less expensive to improve their quality.

Almost any new device applied to a locomotive may be made to show a saving in fuel if it has the fostering care of the inventor or of some officer interested in its success. It is, in fact, difficult to ascertain the value of a change or improvement unless it is applied and managed in such a way as to place it upon its own merits from the start. When new practice is tried it should be subjected not only to the best men, but also the poorest, because general use will embrace the work of all. The usual manner of treating the compound locomotive may profitably be considered in this connection. The Wabash Railroad recently received eight compounds from the Richmond Locomotive Works, four from the Rhode Island and three of the Vauclain type from the Baldwin Locomotive Works. They were all placed in service without in any way indicating that any officer of the road was specially interested in their success more than was usual in any new design. The engines were pooled with others, and in spite of a strong prejudice against them on the part of some of the operating officers it was soon discovered that by reason of the possibility of using high-pressure steam in the low-pressure cylinders at critical points they were able to haul more cars than the simple engines of the same boiler capacity and approximately the same weight on driving wheels. This settled the question with the operating department. The engineers and firemen also became interested in the compounds when they noticed that less coal and less water were required for them and now the men try to get the compounds whenever there is an opportunity for choice. This is one of the best testimonials for compounding that we have seen. It is genuine, natural and an important recommendation, for the men who handle locomotives are critical even to extremes. When inquiring as to the matter of repairs we are told that these compounds are in the shops less than the corresponding simple engines. By this plan the Wabash has most valuable information concerning this type, and it is understood that all new devices and improvements are subjected to the same treatment, this being a searching test which is sure to expose weaknesses or deficiencies when these exist.

That the capacity of draft gear as usually constructed is not believed to be sufficient for the conditions of service with modern powerful locomotives is indicated by the fact that on more than one drawing table designs for tandem and twin-spring arrangements were found. Another design employing an ingenious arrangement for increasing the effectiveness of springs without increasing the spring capacity, which was not completed, indicated a desire to secure increased resistance to the pulling and buffing stresses without increasing to a corresponding degree the recoil of the draft rigging and the consequent danger of breaking the trains in two. This is a step in the right direction. It is a difficult result to reach with a simple construction using a small number of parts, but it needs no argument to prove that a departure from usual construction is necessary.

The presence of the Westinghouse friction draft gear in a number of the shops visited indicates an appreciation of the necessity for better protection of cars and tenders from the excessive shocks of modern conditions of train service. The devices were usually seen in roundhouses and were intended for application to tenders. This is an excellent place to try the gear, for the shocks become greatest at the tenders of heavy engines, and experience at this point is sure to indicate what may be expected in other parts of the train. It is not only the repairs of the draft gear itself that this device overcomes, but also collateral damages to the entire end structures of cars, and in addition to this the destructive wrecks, due to broken trains, are practically prevented. Recent tests with long trains of steel cars and the heaviest of locomotives, carried out on the Bessemer road, indicate the extreme difficulty of breaking trains in two, even when the train crews systematically try to do so by setting a number of brakes at the rear of the train and deliberately put the entire power of their heaviest engine into a jerk test. We congratulate those who are taking up the subject of improved draft gear. It appears to us to be the most important subject in connection with cars at this time.

Anxiety about the breakage of staybolts has not been reduced, but increased, during the past few years. Higher pressures do not appear to have increased the present rate of breakage, but it is apparent that the fear of neglect in inspection and the fact that large numbers of broken bolts are frequently found together with the tendency toward still higher pressures causes a great deal of uneasiness. It has brought a number of conservative motive power men to look at relief, even when accompanied by considerable expense, as justifiable. It is to be hoped that it will not be necessary to wait for explosions to bring about a right view of this. Flexible stays which will save side sheets and avoid explosions will be cheap at $1 each, but they may be made for half that amount.

The Navy Department has called for bids for five new battleships and six armored cruisers. The specifications for the battleships call for double-decked turret ships, 435 ft. long on the load water line. The extreme breadth of the water line is to be 76 ft. 10 in. and the trial displacement about 15,000 tons for the sheathed and coppered vessels and 14,600 tons for those unsheathed. They are designed to travel 19 knots an hour and are to have 3,590 tons of armor. The cruisers will be 502 ft. in length, load water line, and 69 ft. 6 in. in width. They will have a speed of 22 knots an hour. The draft will be 26 ft. when loaded and 24 ft. with the ordinary service load. The weight of armor on each cruiser is to be 2,119 tons, with 100 tons of cellulose backing.

The Boston & Albany Railroad having been leased to the New York Central, the mileage of the Albany road will now be added to that of the New York Central, and hereafter a thousand-mile ticket of the New York Central & Hudson River Railroad will be good on the Boston & Albany Railroad. This will prove a great convenience to those who desire to reach points in Massachusetts on or reached via the Boston & Albany, including, of course, Boston. The holder of a New York Central thousand-mile ticket will now have the privilege of riding over lines aggregating more than 6,000 miles of railroad on a ticket costing only two cents per mile, good for the person presenting it and good until used.

Mr. Asa M. Mattice has been appointed Chief Engineer of the Westinghouse Electric and Manufacturing Company, and will enter upon his duties in December. Mr. Mattice was for ten years, up to a year ago, principal assistant to E. D. Leavitt, of Cambridgeport, Mass., and has been actively connected with the design of all the large machinery coming from Mr. Leavitt's office during that time. Mr. Mattice is an engineer graduate of the Naval Academy, of the class of '74, of which class Mr. E. H. Warren, vice-president of the Westinghouse Electric and Manufacturing Company, is also a member. He was assistant to Admiral Melville at the beginning of the new navy. The Westinghouse Company is to be congratulated on the additional strength which he will give to their already strong engineering staff.

COAL CARS OF 80,000 POUNDS CAPACITY.

Chicago, Burlington & Quincy Railroad.

The new coal cars of 40 tons capacity, of which 500 have been built, for the Chicago, Burlington & Quincy Railroad, have several interesting features. The cars are low and are mounted upon low trucks of the diamond frame type, with 5 by 9 in. steel axles. They are all for use in the coal trade, and in order to adapt them to other kinds of service the ends are fitted with doors hinged to fold down inside the cars and against the floors, as shown in Fig. 2. The order was divided into two lots, of which 300 are plain gondolas to be unloaded by shoveling, while the remainder have Johnson hoppers and hopper doors. Our engravings illustrate the hopper cars, the others being similar to these in general features, but they weigh 29,600 lbs., or 2,400 lbs. less than the hopper cars.

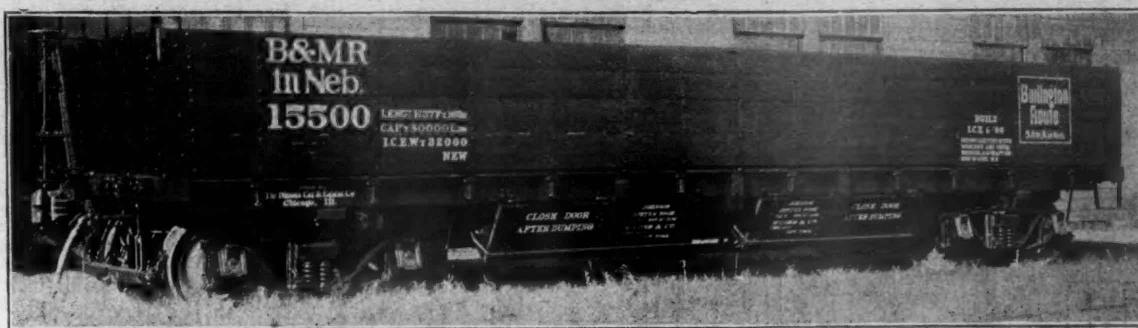
All the cars have six sills, their arrangement on the plain cars being such as to permit of attaching hoppers if desired. The stakes are inside of the siding and five of them on each side of the car extend below the side sills to receive 5 by 2¼ in. braces, as shown in Fig. 3. The chief dimensions of the cars are as follows:

80,000-Pound Coal Cars, C., B. & Q. R. R.

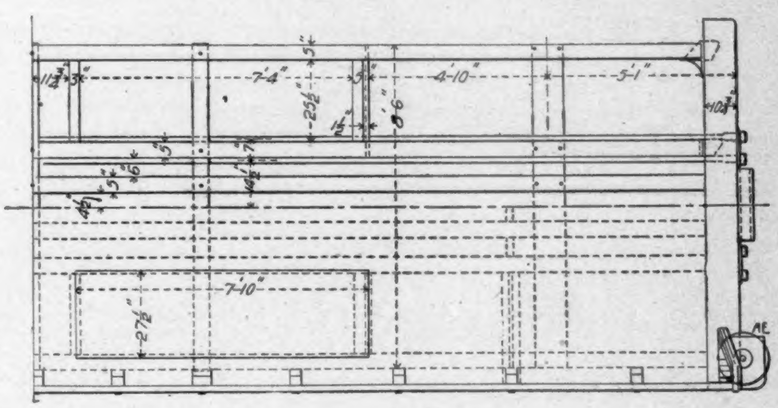
Length over end sills	37 ft. 10 in.
Length of box	37 ft. 3½ in.
Width over side sills	9 ft. 9 in.
Width of box, inside	9 ft. 4 in.
Height, top of rail to floor	3 ft. 7½ in.
Height, top of rail to top of box	7 ft. 4¾ in.
Height, top of rail to sills	2 ft. 10½ in.
Depth of box	3 ft. 7 in.
Distance, center to center of trucks	27 ft. 7½ in.
Trucks, wheel base	5 ft. 2 in.
Weight of cars when new	32,000 lbs.

The hopper openings are 7 ft. 10 in. by 2 ft. 3 in., and these are covered by hinged doors which may be closed at will. When the car is to be unloaded through the hoppers these doors are opened, as in Fig. 2, before loading. The construction of the hoppers is clearly shown in the engravings. Unloading through hoppers is advantageous in the matter of cost, as about half the load may be discharged by gravity, and such cars are becoming so common that shippers are fitting up their trestles to accommodate them.

In Fig. 3 in the upper right-hand corner of the plan view



Coal Car, 80,000 Pounds Capacity—C. B. & Q. R. R.
Fig. 1.—Showing Johnson Hopper Doors.



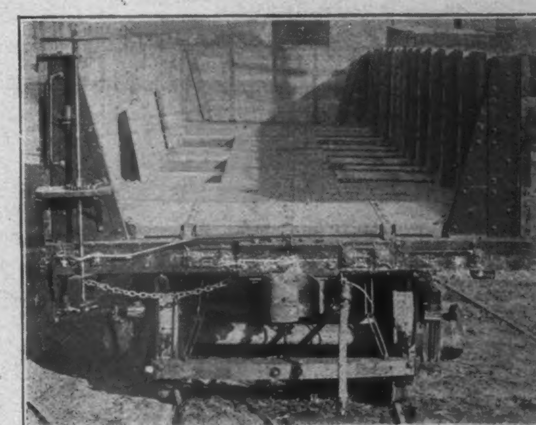
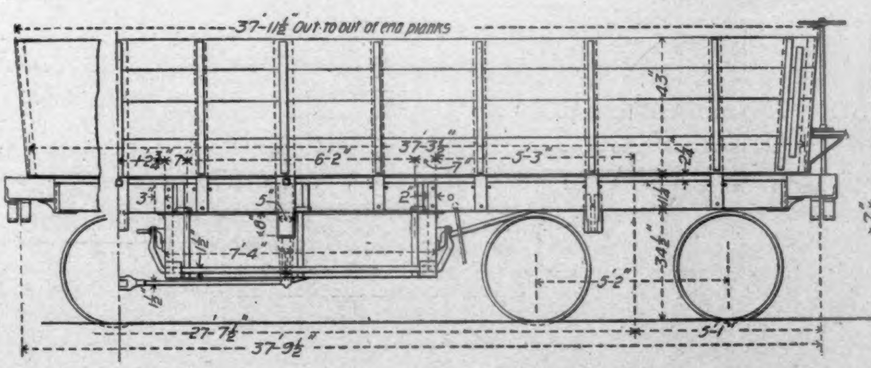


Fig. 2.—Interior View, Showing Open End and Floor Trap Doors.



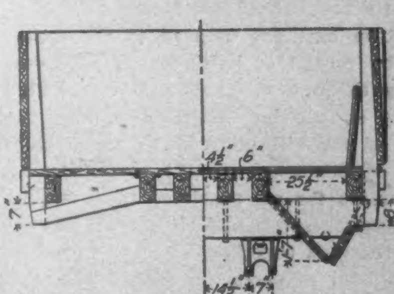


Fig. 3.—Elevation, Plan and Section.

will be seen a malleable iron sill pocket. This view also shows the arrangement of the truss rods and needle beams. The end construction of the box, or body, is such as to guard against weakness due to cutting away so much material for the end doors. Fig 4 illustrates the 1-in. combination rod and strap which passes through the end sill, along the edge, and over the top of the fixed portion of the end structure, where it is secured to the siding at the corner. The end doors slope away from the center of the car.

The Dayton draft rigging is fitted to 250 of the cars, the remainder having the Miner attachment. The adaptation of the Bettendorf bolsters to this construction is illustrated in Fig. 5. Fig. 6 illustrates the draft gear. The stop bars instead of passing through the sills are notched out and bolted beneath them, lipping up on the outside faces of the sills to prevent them from spreading. The stop bars are secured to the center sills by means of bolts which pass vertically through the sills. The drawing clearly shows the construction and the form of the sill plate. The three chief aims of this gear are (1) to reduce all strains, as far as possible, to crushing, avoiding shearing and bending; (2) to bind the sills together, and (3) to reduce the number of parts.

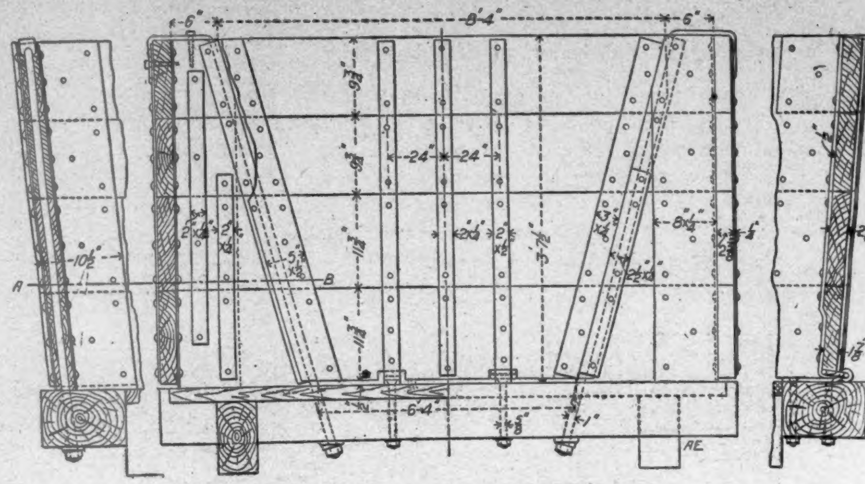


Fig. 4.—Construction of End Doors.

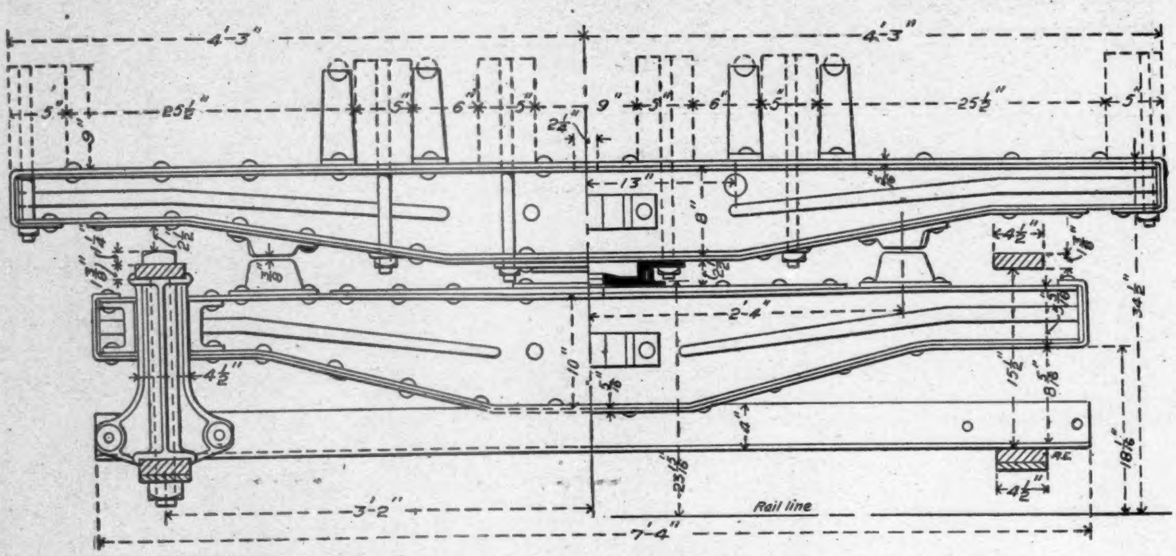
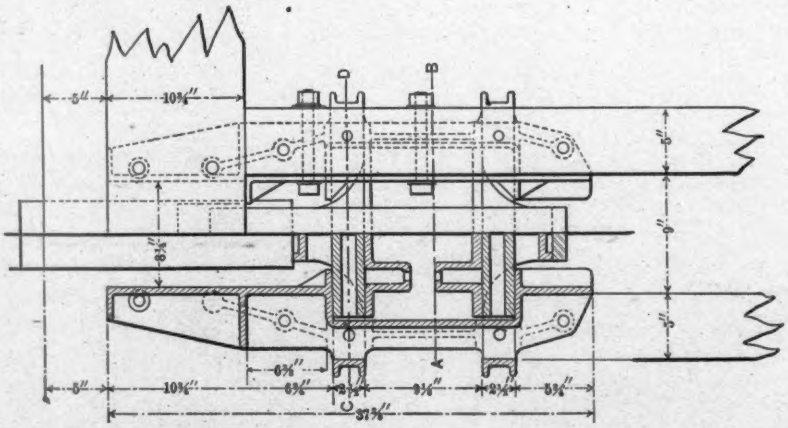
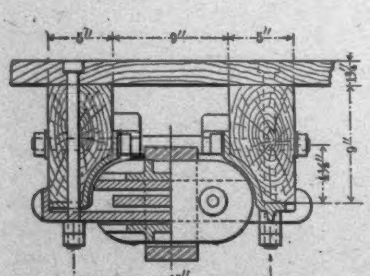


Fig. 5.—Application of Bettendorf Bolsters. 80,000-Pound Cars.—C. B. & O. R. R.





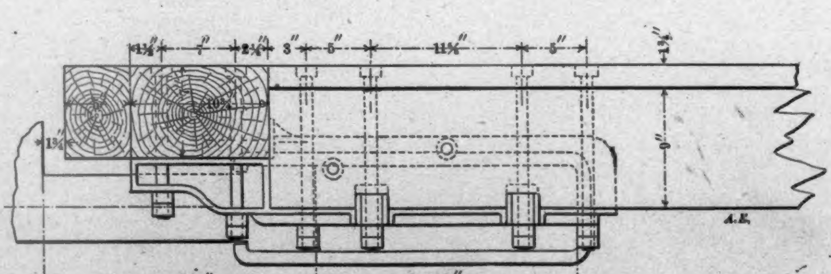


Fig. 6.—Application of Dayton Draft Gear. 80,000-Pound Cars.—C. B. & O. R. R.

The cars are fitted with McCord journal boxes and Westinghouse air brakes, and the Johnson hoppers were applied under patents owned by McCord & Co. The cars were built by the Illinois Car & Equipment Company, Chicago. We are indebted to Mr. F. A. Delano, Superintendent of Motive Power of the road, for the drawings and photographs.

A STUDY IN LOCOMOTIVE FIREBOXES.

For the Benefit of Staybolts.

By F. F. Gaines.

Mechanical Engineer, Lehigh Valley Railroad.

The object of this article is to discuss remedies for the prevention of staybolt failures in the firebox of a locomotive boiler, and to suggest a possibility of discontinuing their use. From the attention devoted to this subject by the technical

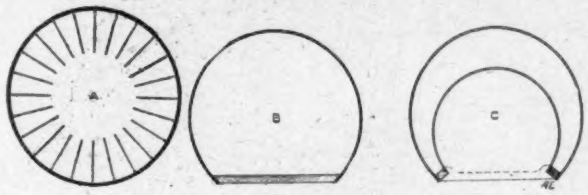


Fig. 1.

press, it is seen to be a very live and important topic. The great increase in the average boiler pressure carried during the last five years has naturally intensified an evil already serious and expensive before its advent. To remedy this trouble there has been but one radical departure from the practice in vogue many years back, and little or no work has been done to obtain an understanding of the causes and remedies. The one departure is what is known in this country as the "Vanderbilt Boiler," and while only an experiment here, I believe it has been in use in Germany for a number of years. To have been of value to the railway world it should have been brought out many years ago. As large grate areas are now being generally introduced, it would seem that its limit in this particular will be fatal to its general use.

Commencing at the fundamental laws of internal pressure

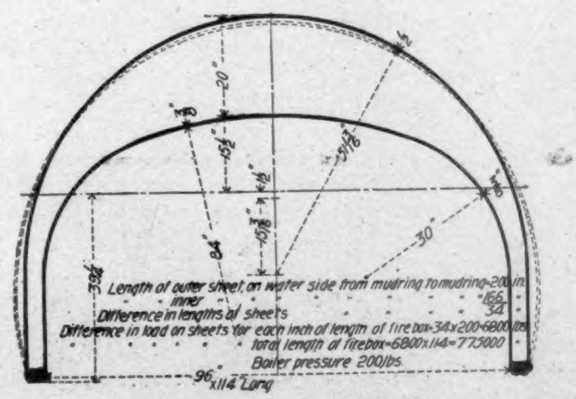


Fig. 3.

on the walls of the containing vessel, we know that if we secure the heads of a cylinder the sides are self-supported (A, Fig. 1) and require no staying. If we should remove a portion of the cylinder and replace the portion removed by a flat surface, sufficiently strong to prevent flexure, and secure this to the walls, as shown in Fig. 1-B, we still have a perfectly self-contained vessel. If we go a step farther and cut out of the flat surface a rectangle and to the inside edges of the band left by the operation secure a portion of another cylinder sufficiently strong to resist collapse under pressure (Fig. 1-C), we have as a result a self-contained vessel of a design applicable as a firebox for a boiler.

To prove that the state of repose of a surface under pressure is a portion of a true circle, the apparatus shown in Fig. 2 was constructed. It consists of two segments of a circle fastened to a base, and a covering of heavy parchment paper, securely fastened, and as nearly air tight as possible. A tube was inserted at each end, one for connecting to air supply and the other for connecting pressure gage. Up to a pressure of 2 lbs. per square inch, at which point a miniature boiler explosion took place, at any point in the length of the parchment, the cross-section was a duplicate of the ends, and a ruler laid from end to end failed to show any distortion whatever. If the state of repose had been a shape different from the segmental ends, with the flexible material and pressure used, we would have had distortion at a section near the

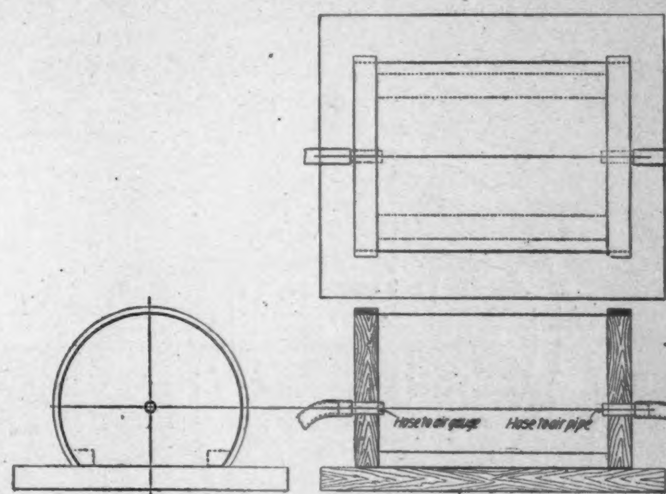


Fig. 2.

center where the influence of the rigid ends was little or nothing, which could not have escaped observation.

Any design which leaves the outer sheet in a state of rest which, no matter how the pressure may vary—from atmospheric to maximum—has no tendency to change its shape, must greatly relieve the distortion and stress of the staybolts. From the same reasoning a design which on the application of

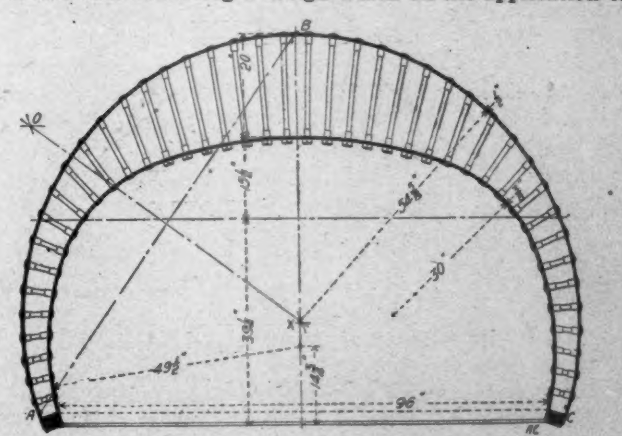


Fig. 4.

pressure tends to assume a different shape must throw abnormal loads on the staybolts, such loads being much greater than the amount due to steam pressure alone, as the bolts have not only to hold against the steam, but to resist a certain extent the tendency of the outer sheet to assume the form of a segment of circle. Theory would indicate that the outer sheet, having a load in excess of the inner, would have a tendency, due to this excess load, to assume a segmental form, the plane of the mud ring forming the chord.

Figs. 3, 5, 8 and 9 are sections of boilers which have been

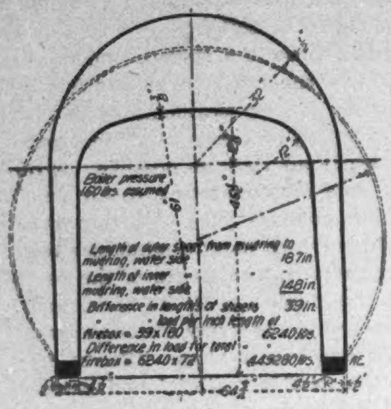


Fig. 5.

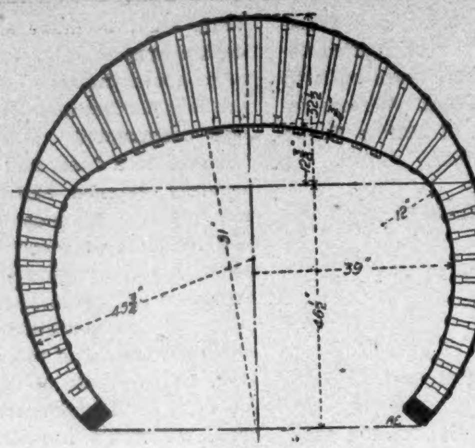


Fig. 6.

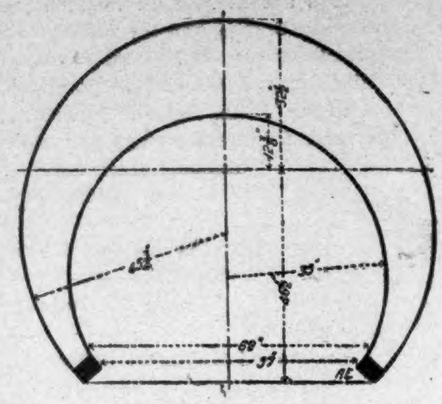


Fig. 7.

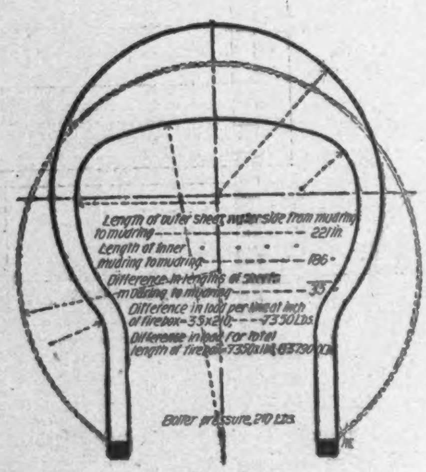


Fig. 8.

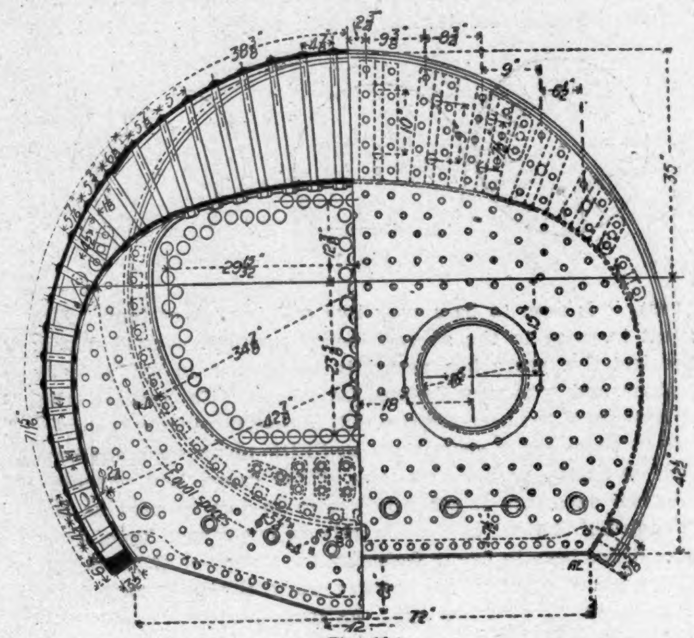


Fig. 11.

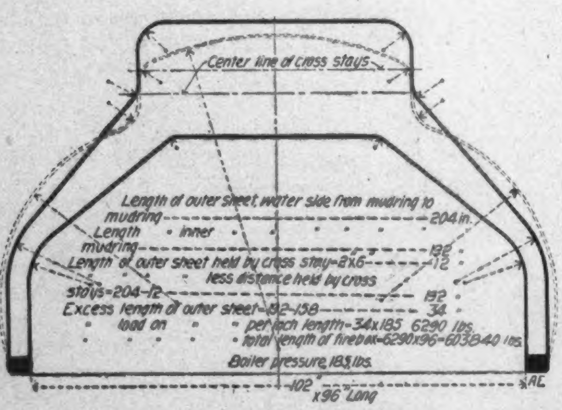


Fig. 9.

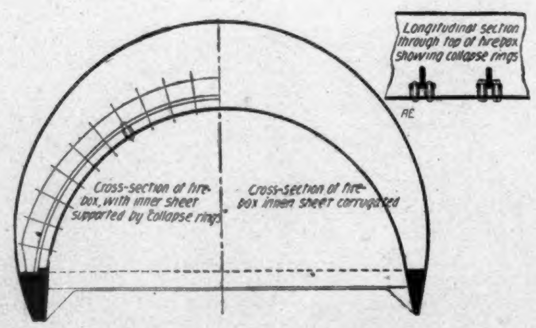


Fig. 10.

A Study in Locomotive Fireboxes. By F. F. Gaines, Mechanical Engineer Lehigh Valley Railroad.

published in the railway papers within the present year, and the dimensions shown are as nearly as possible those of actual boilers. The full lines in Fig. 3 show the section of a wide firebox; the dotted lines, the same length of sheet between the mud-ring joints, but a segment of a circle. The length of the outer sheet on the water side, from mud ring to mud ring, is 200 ins. The length of the inner sheet from the same points, and on the water side, is 166 ins. This gives the outer sheet an excess length of 34 ins. With 200 lbs. pressure and a firebox length of 114 ins., the excess load on the outer sheet, tending to force it to assume the shape shown by the dotted lines, is 775,000 lbs. This design very nearly approaches the theoretical, as shown in Fig. 4, which is interchangeable with that shown in Fig. 3, and has the same leading dimensions. The diameter of the circle of the outer sheet is determined by taking the three points, A, B and C, from Fig. 3, and passing a circle through them. Fig. 5 shows a section of firebox of a width I shall call "The Compromise." The full and dotted lines have the same meaning as in the previous case. The excess load on the outer sheet is less, 449,000 lbs., but the change of shape necessary to attain a state of repose is much greater. Fig. 6 is a section with

the outer shell segmental, and Fig. 7 a section with both inner and outer shells segmental; both Figs. 6 and 7 are interchangeable with the boiler for Fig. 5.

Fig. 8 shows the section of a narrow box. Here the excess load of 837,900 lbs. on the outer sheet has a tendency to cause considerable distortion. The ideal section for this boiler would be similar to Figs. 6 and 7.

Fig. 9 shows a section of a firebox that is a combination of the Belpaire and wide box. From the nature of the cross-staying, it is difficult to say just what the tendency to distortion amounts to, and what the shape of repose; it is probable, however, that it is somewhere near the dotted lines shown. It would depend largely on how far the influence of the cross-stays extends. From the standpoint of this article, its section leaves much to be desired.

If these excess loads on the outer sheets were equally divided between all the staybolts, it would be a matter of no great moment, but it seems probable that this excess is confined to those staybolts that are located at the points where the theoretical and actual lines diverge most widely—provided the divergence causes tension. Taking the firebox sections illustrated, we might expect to find the largest number of broken staybolts at those places of greatest divergence along the sides. On the crown, where the theoretical lines drop below the actual, we might expect to find those stays nearest the ends in compression, where the flue and door sheets support and hold the inner crown sheet rigidly. Experiments that have been made at different times have proved the latter expectation. The reasons that have been given for this state of affairs has generally been charged to the mythical force called expansion. I have never been satisfied with this explanation, and it was the cause of my investigating the matter from all sides. It led up, eventually, to the evolution of the theory that to remedy the known distortion and rupture of staybolts, the outer sheet at least should be in a state of repose. With the outer sheet in this condition, the only forces acting on it are the steam pressure forcing it out and the steam pressure on the inner sheet through the staybolts pulling it in. As the former must always exceed the latter, and as there is no tendency to alter its shape on account of the outward pressure, it is readily seen that there is nothing tending to a change of section under any possible variation of allowable pressure. Under these circumstances, the staybolts have only to carry the normal load on the inner sheet, which load is uniformly distributed among them all. Figs. 11 and 12 show two views of a boiler designed in accordance with this theory. As it was designed for an actual engine, where the limiting wheel weights would not allow any further increase in the weight of the boiler, the inner sheet is not segmental. Were it possible to allow the additional weight due to increasing the water space, the inner sheet could also have been made segmental. This would have resulted in lessening the load on the staybolts, by the amount of strength possessed by the inner sheet against collapse.

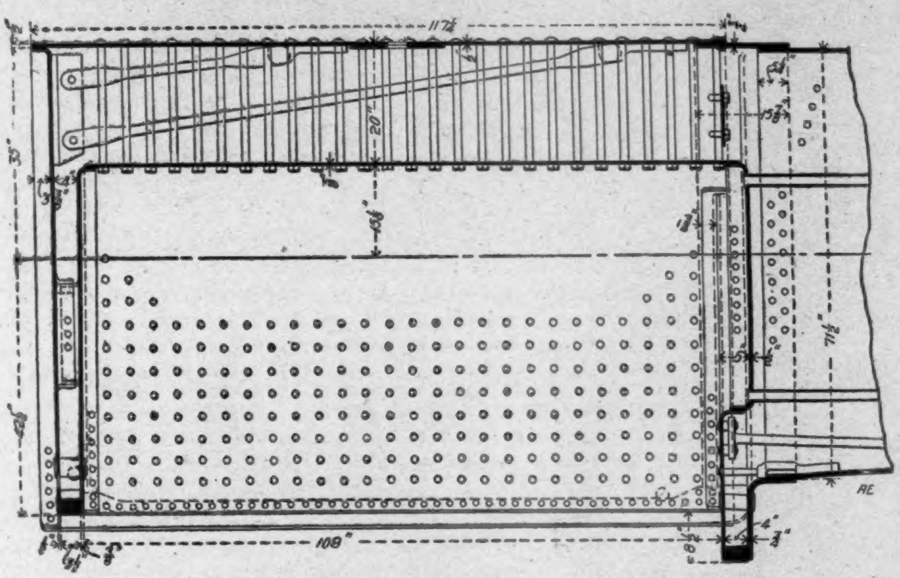


Fig 12.

The segmental firebox, especially where both inner and outer sheets are segmental, has many advantages to recommend it, besides the probable diminution of staybolt failures. With the regular firebox, especially the wide ones, it requires frequent firing to keep coal on the grates at the sides, while the segmental form would remedy this fault. The contour presents a surface that is accessible to the heat at all points, and one which the flame will readily follow from the fire to the crown. The enclosed space is a maximum, thus providing a greater possibility for the thorough mixing of air and gases for production of perfect combustion.

I now wish to take up a phase of the subject of which I have no definite knowledge, but one which I think it is possible to develop, as I see no overwhelming obstacles. Fig. 10 shows a sketch of two firebox sections, neither of which requires staybolts. The outer and inner sheets are segments of circles. On one side a plain inner sheet is shown supported by collapse rings. The tee-shaped collapse ring is shown as being the simplest, but many other forms can be found in any English text-book on boiler design. The other side has the inner sheet of corrugated material, which is self-sustaining against collapse. With a sufficiently strong joint at the mud ring, either style is just as practicable as where the shell is a true cylinder. This design is equally applicable to all widths of grates, but will give a heavier firebox than present designs on account of the greater water space. These spaces on the other hand, would give good circulation, and should make a free steaming boiler. The design of the mud ring calls for special treatment, and the two sides would have to be well tied to prevent a "Bourdon gage" action. Owing to the probable irregularity of section and corners, steel castings would probably prove the most economical for the purpose. To prove the value of such a design, it would be necessary to build an experimental boiler. It is to be hoped that some road, imbued with the spirit of progress, will experiment along these lines in the near future.

"Why has the swing beam truck been so largely abandoned for freight service?" was the subject of a topical discussion at a recent meeting of the New York Railroad Club. The general opinion seemed to be that it was merely a matter of cost of construction and maintenance, the difference between the rigid and swing trucks in these respects being about 10 per cent. in favor of the rigid truck. A good point was made by Mr. L. R. Pomeroy, of the Schenectady Locomotive Works, concerning the possibilities of "saving too expensively" in the matter of trucks. He said: "Some years ago, when it was quite prevalent to use the pressed steel type of truck with pedestal boxes under tenders we found that they were failing very rapidly and continued to do so until the truck was redesigned with a floating bolster which practically made it a swing-motion truck, and now that truck is being very largely used for tenders and is considered to be very successful. That might be an illustration that we are coming back to the swing-motion truck in the most trying service we can possibly get."

PROMISING IMPROVEMENTS IN DRAFT GEARS.

The draft-gear situation is encouraging. With the amount of thought now devoted to it, draft gear is bound to improve, and the awakening of interest will bring about a radical change which everyone knows is greatly needed. More money will be put into draft gear in order to save greater expenses in repairs which will be necessary on account of the weaknesses of the old types of attachments.

Some radical differences of opinion may naturally be expected in such a matter. Mr. George Westinghouse, in a recent communication to the "Railroad Gazette," represents one view when he says: "By their united action a form of coupler and draft gear adequate to meet all possible contingencies can and should be selected and decided upon as a standard for all new cars, and which will also be suitable to replace the hundreds of imperfect and weak kinds now in service."

Mr. R. P. C. Sanderson thinks otherwise. He may always be depended upon for an opinion, carefully formed, and vigorously supported, from observation, but with a liberal disregard of the weight of the opinions of the majority, merely because they are those of a majority. In his paper before the Western Railway Club last month is the following paragraph:

"Having reached the conclusion that in modern train service the train shocks were of such momentum as to be quite beyond the power of any reasonable springs to absorb (and assuming we had spring capacity to do this, the recoil would itself cause break-in-twos), the malleable-iron dead block becomes a necessity to protect the couplers. There is trouble enough with the M. C. B. coupler to-day without making it act as a collision buffer. It is too expensive to be used to take up shocks that are beyond the capacity of the draft springs."

It seems reasonable to suppose that many coupler failures are due to inadequate yielding resistance, and that if sufficient soft resistance is provided the couplers will not suffer. May it not be a step backward to rely upon buffer blocks which will carry some of the shock to the framing direct? On the other hand, the break-in-twos are caused by pulling or jerk stresses, and the dead blocks will not avail in the least in that case.

At the beginning of these comments it was said that the draft gear situation is encouraging. This is confirmed by results of tests on a number of new draft gears recorded by Mr. Sanderson in his paper. One of the nine draft gears was not damaged at all under a 1,640-lb. drop, with three blows at 5 ft., 10 blows at 10 ft. (with the springs in place), then 3 blows at 5 ft. (with blocks in place of the springs) and 7 more blows at 10 ft. (with the blocks in place of the springs). At this stage in the test the pocket bolts began to shear, but after they were replaced the punishment was continued by 3 more 10-ft. blows (with the blocks), and 13 more beginning at 10 ft. and increasing by 1 ft. each time up to 20 ft., the test ending with 3 20-ft. blows. Beyond the shearing of the bolts a second time, and the bending of one of the stop bars, there seemed to be no damage to the gear. This was a twin-spring gear having malleable draft beams, with the cheek plates incorporated into the draft beams. Mr. Sanderson's tests, while not conclusive, furnish information which is valuable in the selection of gears to those who know the names of the ones tested, and they certainly indicate considerable improvement in the matter of strength. But the drop test needs to be supplemented with something like 40 or 60-car train tests, in order to throw light on the question of break-in-twos. Strength or spring capacity does not cover all the desirable qualities, and in this all will agree with Mr. Sanderson.

A clean gift of one million dollars from Andrew Carnegie, and a promise of more if needed, will establish a technical school in Pittsburgh. It will be founded on the idea of offering technical nstruction to self-supporting students and place the privileges of education within the reach of artisans and mechanics. It will fill a great need, but considerable difficulty in finding the right sort of instructors may be expected.

THE CONFUSION OF TYPES.

A Logical Locomotive Classification Needed.

The past year has brought out a large number of different locomotive designs, and probably a greater variety than have ever appeared in a similar period, and there are more to come. It is desirable that each class should have a name representing its characteristics in some logical way which will correspond with the usual type designations which generally refer to the wheel arrangement. The number of "types" is increasing, and the nomenclature is tending toward confusion. The "ten-wheel" type is now likely to be confused with the "Atlantic," the "Northwestern," the "Chautauqua," the "Fan Tail," the "Consolidation" and others yet to come, which have ten wheels, unless some simple scheme of classification is devised. We also have the "Decapod" and the "Mastodon" and the "Twelve-Wheel" types. There are too many names, and the tendency is to give a type designation to a new design the only peculiarity of which is the outside or inside journals of the trailing wheels. Mr. F. M. Whyte, Mechanical Engineer of the New York Central, comes to the rescue with a suggestion which seems to meet the requirements in every way, and it is presented with a view of obtaining criticisms and suggestions. The plan is to designate the number of wheels in three groups; those in front of the drivers, the drivers themselves, and those in the rear of the drivers. An 8-wheel engine is a 4-4-0 (or a 4-4), a 10-wheel is 4-6-0 (or 4-6), an Atlantic type 4-4-2, a consolidation 2-8-0 (or a 2-8), the Prairie type 2-6-2. Any possible wheel arrangement may be covered by this simple classification. If such a classification is adopted the present confusion of type names may be overcome. If any of our readers can suggest a better plan we shall be glad to have it, with their criticisms on this one.

Mr. J. Shirley Eaton, Statistician of the Lehigh Valley Railroad Company, has been engaged to give a course of lectures during January, 1901, before the students of the Tuck School of Dartmouth College, upon the "Theory and Practice of Railroad Statistics." Mr. Eaton is well qualified by his many years of special experience in railroad accounting for the novel course of lectures which he is to undertake. The course will include a general discussion of railroad revenue and expenditure, followed by a detailed study of freight and ticket accounts and statistics, operating statistics, store requisitions, car accounting, and the general books, such as balance sheet, various journals, side ledgers, and accounts and reports of the Superintendent's office, and of the Master Mechanic and the Division Engineer.

The Car Foremen's Association of Chicago, an organization of men who have to do directly with the M. C. B. interchange rules, and who meet for discussion of the rules, deserves encouragement as it is doing a good work which should be a material help to the M. C. B. Association. At the November meeting, Mr. J. C. Grieb, of the Chicago, Milwaukee & St. Paul Railroad, presented an analysis of the 603 cases which have been decided by the Arbitration Committee, and made some excellent suggestions looking to a reduction of the number of uses submitted. The first was rendered in 1888, and their number has averaged about 50 per year. The Car Foremen's Association furnished means for coming to an understanding among its members, and one result to be expected from it is a reduction of the number of disputed cases through better personal understanding at the interchange points. Mr. Grieb suggests the importance of a complete index of the decisions as a guide to the settlement of cases by reference to previous decisions. He also recommends less brevity and more explicit language in the decisions themselves in order that the reasons of the committee forming the basis for a decision may be better understood. Citing the rules used as authority for a decision would meet Mr. Grieb's recommendation. These matters should be brought to the attention of the M. C. B. Association next year.

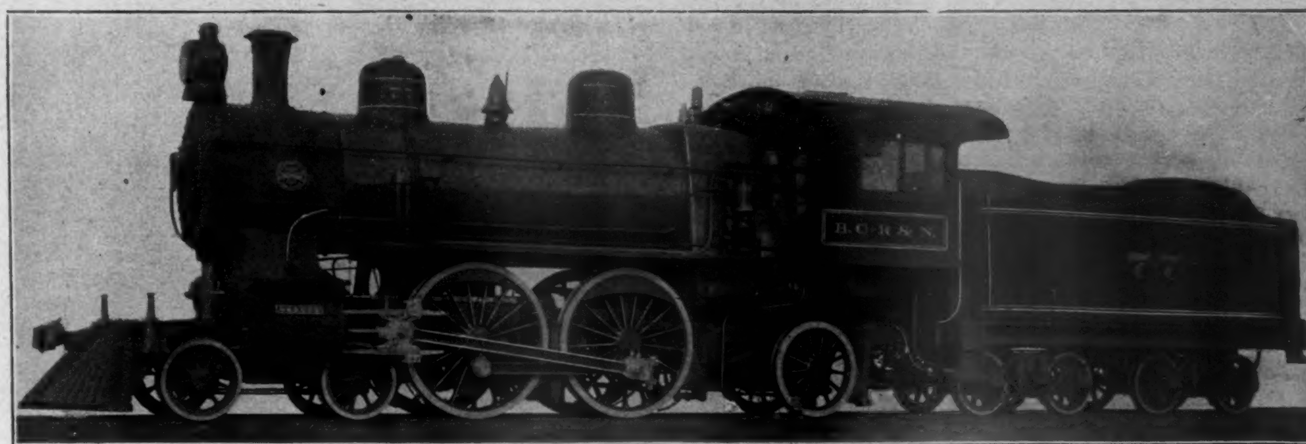
PASSENGER LOCOMOTIVE WITH WIDE FIREBOX.

Burlington, Cedar Rapids & Northern Railroad.

Brooks Locomotive Works, "Chautauqua" Type.

Three interesting passenger locomotives with wide fireboxes have just been delivered by the Brooks Locomotive Works to the Burlington, Cedar Rapids & Northern. They are called "Chautauqua" type, but it is to be hoped that each new design is not to be christened with a name, or the confusion will soon be complete. The wheel arrangement is that of the old Atlantic type. The engine combines the wide firebox, Belpaire boiler, piston valves and a radial trailing truck.

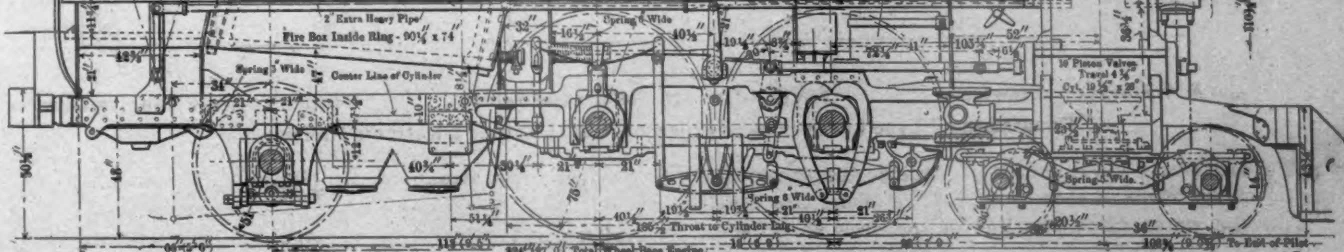
The firebox is wide and deep, with a brick arch supported on water tubes. With 75-in. drivers, the center of the boiler is 9 ft. 2½ ins. above the rail. A radial truck is a novelty which has been skilfully applied, and it gives an excellent arrangement of the back end of the engine and leaves plenty of room for the ash pan. The truck has a spring centering device and is as simple as one could wish. It permits of carrying the frames straight to the rear ends, and a cross equalizer at the rear of the main driving wheels gives a good arrangement for the equalization of the weight. Three points of support are provided for the rear equalizers whereby greater or less weight may be placed upon the drivers as may be desired. This is accomplished by changing the position of pins upon which these equalizers rest. Cast steel is used for the main equalizers and the driving springs are 6 ins. wide, the trailer springs being 5 ins. wide. A good arrangement of the front frames is secured by the location of the piston valves and the stresses must necessarily be quite direct with the use of the single bar in front, which is straight and deep in section.



PASSENGER LOCOMOTIVE, WITH WIDE FIREBOX—"CHAUTAUQUA" TYPE.

BURLINGTON, CEDAR RAPIDS & NORTHERN R. R. — BROOKS LOCOMOTIVE WORKS, *Builders.*

Weights: Total of engine........ 158,600 lbs.; on drivers............88,000 lbs.; total of engine and tender .... 265,600 lbs.
Wheel base: Driving.......6 ft 9 in.; total of engine........ .....27 ft.; total of engine and tender ....52 ft. 11¼ in.
Cylinders. 19½ x 26 in. Wheels: Driving ... .75 in; truck ....36 in; tender............ 36 in.
Boiler: Diameter....... 64 in; boiler pressure.......... 210 lbs.
Firebox: Length. ......90¼ in.; width ....74 in.; depth, front .... 68 in.; back............57 in.
Grate area... 45.32 sq. ft. Tubes: 306; 2 in., 15 ft. 1 in long.
Heating surface. Tubes ..... 2,396 sq. ft.; firebox. ...... 155.8 sq. ft.; total .. ..2,551.8 sq. ft.
Tender: Eight-wheel; water capacity............5,000 gals.; coal capacity...... .....10 tons.



Passenger Locomotive, with Wide Firebox—Burlington, Cedar Rapids & Northern Railroad.

With 75-in. wheels, 19½ by 26-in. cylinders and 210 lbs. boiler pressure, the tractive power is 22,409 lbs. The tubes are 15 ft. long and the boiler 64 ins. in diameter. Among the details we note that the piston valves are 10 ins. in diameter with central admission. The valve chamber is extended at the ends in order to give free exhaust passages without increasing the steam clearances by increasing the length of the steam admission ports. Marine links are used, giving a valve travel of 4¼ ins. The boiler is supported by plates secured to the front and rear water legs of the firebox, the front plate being fastened to a cast-steel lateral brace extending across

the engine between the frames. The cab deck is supported on angles secured to the cab plate and the cab bracket, which is also a plate.

For a wide firebox engine the cab is remarkably roomy, to which the sloping back head of the boiler contributes. It is of steel and 10 ft. wide. The Bell front end is used, with a straight cinder spout for which there is just room enough in front of the saddle. The reach rod is of 2-in. extra heavy pipe. With this arrangement of valves both rocker arms are inside the frames. The sectional drawings show this clearly. Attention is attracted to the location of the driver brake cylinders at the front drivers, with the brake shoes at the rear of the driving wheels, which is becoming quite general in passenger locomotives. In this case the main reservoir is 31¼ by 46 ins. and is located with its axis vertical, under the boiler and in front of the forward driving axle. We note the large journals throughout and enlarged wheel fits of the main crank pins. Another interesting detail is the grate bearer, which provides for a packed joint against the inside firebox sheet to prevent the passage of air at the edges of the grates. This should become general practice because it prevents the destructive blowpipe action against the sheets due to the inrushing of air at these points. The tender has a coal deck over the water space, the line of the deck sheet being indicated by the rivets seen in the photograph. The tender has steps at the rear end.

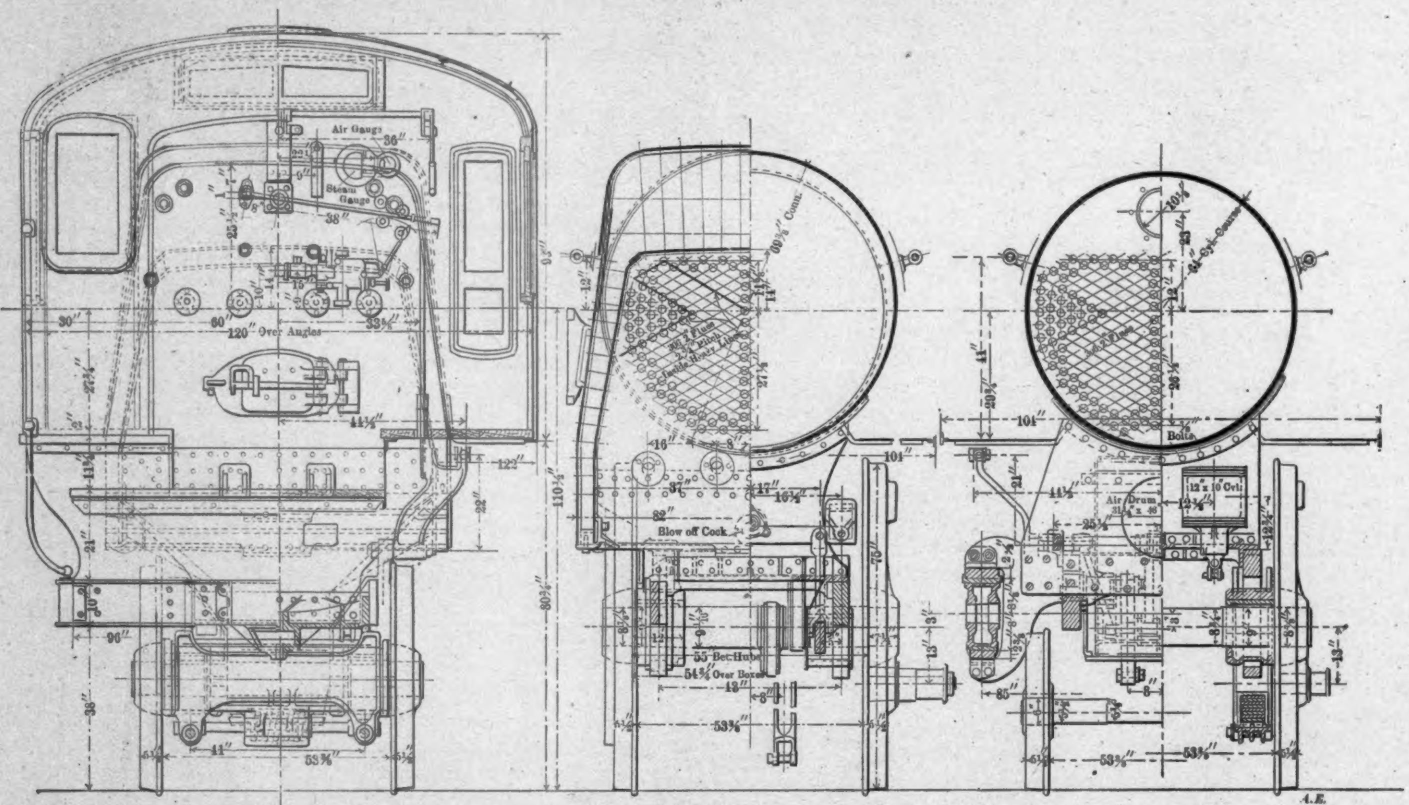
To facilitate comparison with the new Chicago & Northwestern engine built by the Schenectady Locomotive Works (see American Engineer, August, 1900, page 237), the principal dimensions are arranged in parallel columns in the following table:

Comparisons of "Chautauqua" and "Northwestern" Type Locomotives.

Builder	Brooks.	Schenectady.
Type	"Chautauqua."	"Nortnwestern."
Operating road	B., C. R. & N. Ry.	C & N. W. Ry.
Gauge	4 ft. 8½ in.	4 ft. 8½ in.
Kind of fuel to be used	Bituminous coal.	Bituminous coal.
Weight on drivers	88,000 lbs.	90,000 lbs.
" truck	35,600 lbs.	35,000 lbs.
" trailer	35,000 lbs.	37,000 lbs.
Weight, total	158,600 lbs.	162,000 lbs.
" tender, loaded	107,000 lbs.	....

General Dimensions.

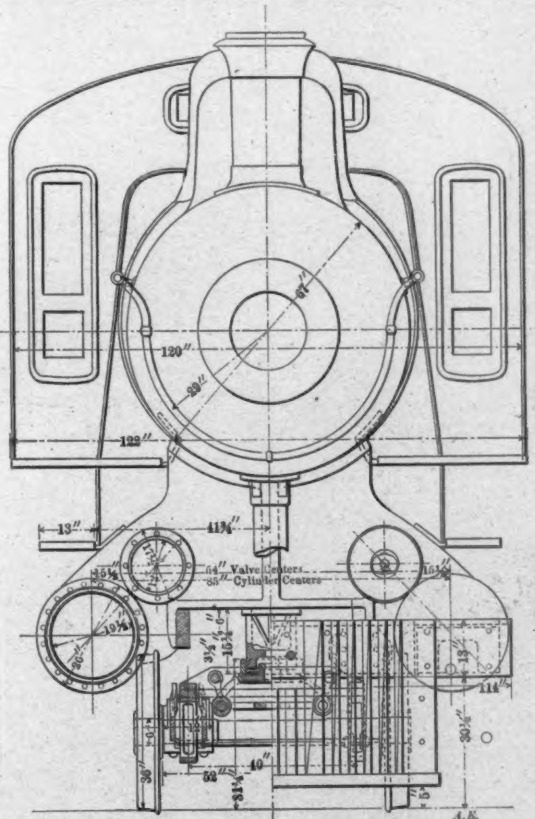
	"Chautauqua."	"Northwestern."
Wheel base, total of engine	27 ft. 0 in.	23 ft. 9 in.
" driving	6 ft. 9 in.	7 ft. 0 in.
" rear driver to trailer	9 ft. 5 in.	9 ft. 0 in.
" total, engine and tender	52 ft. 11¼ in.	....
Length over all, engine	38 ft. 11½ in.	....
" " total, engine and tender	62 ft. 4½ in.	....
Height, center of boiler above rails	9 ft. 2½ in.	9 ft. 1½ in.
Height of stack above rails	14 ft. 11 in.	15 ft. 1½ in.
Heating surface, firebox	155.8 sq. ft.	198.97 sq. ft.
" tubes	2,396 sq. ft	2,816.91 sq. ft.
" total	2,551.8 sq. ft.	3,015.88 sq. ft.
Grate area	45.32 sq. ft.	46.27 sq. ft.
Wheels and Journals.		
Drivers, number	4	4
" diameter	75 in.	80 in.
" material of center	Cast steel.	Cast steel.
Truck wheels, diameter	36 in.	36 in.
Trailing wheels, diameter	51 in.	48 in.
Journals, driving axle	9 in. x 12 in.	9 in. x 12 in.
" truck "	5½ in. x 12 in.	6 in. x 10 in.
" trailing "	8 in. x 14 in.	7½ in. x 12 in.
Main crank pin, size	6½ in. x 6½ in.	....
" coupling pin, size	7 in. x 4½ in.	....
" diameter, wheel fit	7⅝ in.	....
Trailing axle, type	Radial.	Rigid.
Cylinders.		
Cylinder, diameter	19½ in.	20 in.
Piston, stroke	26 in.	26 in.
" rod, diameter	3⅝ in.	....
Main rod, length center to center	124½ in.	....
Steam ports, length	22 in.	....
" width	1⅞ in.	....
Exhaust ports, least area	75 sq. in.	....
Bridge, width	2⅝ in.	....
Valves.		
Valves, kind of	10 in. piston.	11 in. piston.
" greatest travel	4¼ in.	....
" steam lap inside	1 in.	....
" exhaust lap or clearance (outside)	line and line.	....
Valve Motion, Forward Gear.		
Lead, full gear	3/32 in.	....
" 6 in. cut-off	¼ in.	....
Port opening 6 in. cut-off	5/16 in.	....
Pre-admission 6 in. cut-off	11/16 in.	....
Exhaust opens "	17½ in.	....
Cut-off, full gear	21½ in.	....
Valve Motion, Backward Gear.		
Lead, full gear	− 3/32 in.	....
" 8 in. cut-off	+ 3/16 in.	....
Port opening, 8 in. cut-off	5/16 in.	....
Exhaust opens "	18¾ in.	....
Cut-off, full gear	21½ in.	....
Boiler.		
Boiler, type of	Player-Belpaire wagon top.	Radial stayed straight top.
Boiler, working steam pressure	210 lbs.	200 lbs.
" material in shell	Steel.	....
" thickness of material in shell	⅝, 11/16, 9/16, and ½ in.	⅝ in.



Section and End Elevation at the Cab. Section Through Boiler and Firebox. Section Through Running Gear.

"Chautauqua" Type Locomotive—Burlington, Cedar Rapids & Northern Railway.

	"Chautauqua."	"Northwestern."
Boiler, thickness of tube sheet	¾ in.	...
" diameter of shell, front	64 in.	68 in.
" " " at throat	69⅝ in.	69¾ in.
" " at back head	64 in.	69¾ in.
Seams, kind of horizontal	Sextuple butt and quintuple lap.	...
Seams, kind of circumferential	Double and triple lap.	Double lap.
Crown sheet stayed with	Direct stays.	Radial stays.
Dome, diameter	30 in.	30 in.
Firebox.		
Firebox, type	Long sloping over trailer.	Long sloping over trailer.
Firebox, length	90¼ in.	103 in.
" width	74 in.	66 in.
" depth, front	68 in.	76¼ in.
" " back	57 in.	67 in.
" material	Steel.	...
" thickness of sheets	Crown, ⅜ in.; tube, ⅝ in.; sides and back, ⅜ in.	Crown, ⅜ in.; tube, ½ in.; sides and back, ⅜ in.
" brick arch	On 4 water tubes.	On 4 water tubes.
" mud ring width, back	3½ in.	3½ in.
" " " sides	3½ in.	3½ in.
" " " front	4 in.	4 in.
" water space at top, back	7 in.	...
" " " sides	5 in.	...
" " " front	4 in.	...
Grates, kind of	Rocking.	...
Tubes, number of	306.	338.
" pitch	2¾ in.	2$\frac{11}{16}$ in.
" outside diameter	2 in.	2 in.
" length over tube sheets	15 ft. ⅞ in.	16 ft. 0 in.
Smokebox.		
Smokebox, diameter outside	67 in.	71¼ in.
" length from flue sheet	58½ in.	71⅞ in.
Other Parts.		
Exhaust nozzle	Single.	...
" area	17.7 sq. in.	...



Front Elevation and Section through Cylinders.

Netting, wire or plate	Wire.	...
" size of mesh or perforation	2½ x 2½ in.	...
Stack, straight or taper	Taper.	Taper.
" least diameter	15⅝ in.	...
" greatest "	17½ in.	...
" height above smokebox	35 in.	36 in.
Tender.		
Type	8-whl. steel frame.	8-whl. steel frame.
Tank, type	Slope top.	...
" capacity, for water	5,000 gals.	5,200 gals.
" " " coal	10 tons.	...
" material	Steel.	...
" Thickness of sheets	¼ in.	...
Type of under frame	10 in. steel chan'l.	...
" truck	B. L. W. 100,000 lbs.	...
" springs	Double elliptic.	...
Diameter of wheel	36 in.	...
" and length of journal	5 in. x 9 in.	5 in. x 9 in.
Distance between centers of journals	76 in.	...
Diameter of wheel fit on axle	6⅝ in.	...
" center of axle	5⅝ in.	...
Length of tender over bumper beams	21 ft. 1½ in.	...
" tank	19 ft. 6 in.	...
Width of tank	10 ft. 0 in.	...
Height of tank, including collar	5 ft. 0 in.	...

In a paper upon compressed air motors read before the New York State Street Railway Association, Mr. H. D. Cooke recently stated that the advantage in reheating the air for the motors to an initial temperature of 300 deg. made the difference between a possible mileage of 8 and 15 miles which could be run with a storage capacity of 35 cu. ft., the distance traveled with cold air. Cars operated for six months in Chicago required an average of 409 cu. ft. of free air per mile, which was compressed to 2,000 lbs. per square inch for storage. In brief, the advantages of compressed air for the operation of street railways may be summed up as follows, viz.:

1. A system of independent motors, which, after receiving their charges, does not rely upon the power plant, and which will always finish their run, should anything happen to the power plant; which also does not need any special out-door construction, either underground or overhead, with the attendant cost of maintenance.
2. Slow-moving machinery, both in the power house and on the car, which is easily maintained.
3. Opportunity for charging cars, and storage in power house, during light hours, for use during rush hours.
4. Spring-supported motors and load, doing away with excessive jarring and pounding on the track, and thus greatly prolonging the life of the roadbed, the life of the motors, and contributing to the easy riding of the cars.
5. Low first cost of plant, low cost of maintenance and opportunity for making repairs and adjustment without stopping operation of cars.
6. Freedom from liability of delay in transit from snow, ice or sleet.

Steel rail production has had a marvelous history during the thirty-two years since it began. In 1868, says the Railway Age, rails sold at $174 a ton, but even at this price a few railway companies had decided that it was economy to begin to use them instead of iron. Ten years later, in 1878, the price had dropped to $41.50, and about one-quarter of the railway mileage of the country was of steel rails. During the next ten years the price first doubled, reaching $85 in 1880, and then declined to $31.50 in 1888, by which time there were 130,388 miles of steel tracks, against 52,979 miles of iron. At the end of another decade, in 1898, the price had fallen to $18, and there were 220,800 miles of steel tracks, only about 24,000 miles of iron remaining. The following year, 1899, saw nearly 9,000 miles of steel added, although in the course of the year, the price had almost doubled. To-day the mileage of steel is about 230,000, as compared with 20,000 miles of iron—that is, 92 per cent. steel and 8 per cent. iron—and the battered relics of the iron age that still linger in scattered sidings and spur tracks will soon disappear. Although the price, $26, fixed by the mills for the coming year, is an advance of $8 over the price at the commencement of 1899, it is less than the average quotation for that year. But it is a higher figure than the large purchasers expected to pay and if maintained may somewhat diminish the amount of new construction and renewals which had been planned on the expectation of a lower price. Still, compared with $174 a ton, even $26 seems cheap.

A reduction in the size of auxiliary reservoirs for 16-in. air-brake cylinders is recommended by the Westinghouse Air Brake Company. Heretofore they have recommended a special auxiliary reservoir 18½ by 41 ins. in size for use in connection with 16-in. cylinders upon the assumption that the brake arrangement for locomotives requiring cylinders of this size would not admit of a piston travel shorter than 6 ins. A further study of the situation, however, has resulted in a series of brake designs in which the minimum piston travel may be advantageously reduced to 4 ins., and on this basis careful experiments have shown that the most satisfactory results can be obtained by reducing the size of the auxiliary from 18½ ins. by 41 ins. to 16 ins. by 42 ins. The latter size has, therefore, been adopted as standard for use in connection with 16-in. cylinders of all kinds.

PULVERIZED FUEL.

About ten years ago D. K. Clark referred to the use of powdered coal as "unique and interesting." It is now much more than that and is worthy of the most careful attention of engineers in view of its apparently very promising possibilities. The idea dates back to 1831, when Henschel carried out experiments at Cassel, Prussia, in connection with brick kilns and heating furnaces. While progress has been made continually it was not until recently that commercial success has been attained in practical operations, but its present employment in connection with the manufacture of cement in this country and also in firing boilers both here and abroad entitle it to a consideration which it has not yet attracted.

The burning of fuel in finely divided form permits of turning the fuel into gas and obtaining a perfect and prompt intermixture of the gas and air. This constitutes perfect combustion, which is necessarily smokeless, and there is good reason to believe that the results are almost as good with poor as with good grades of coal, but, of course, the better the coal the less is required. By passing the fuel into the furnace by means of a stream of air the regulation of the elements of combustion is under perfect and convenient control, and one great advantage of the automatic stoker is attained in that there is no opening of fire doors. That the combustion may take place under ideal conditions is evident from the fact that powdered coal has been burned with the proportion of 12 lbs. of air per pound of coal, which is precisely the theoretical chemical requirement. We have also records of continuous tests showing 18 per cent. of carbonic acid gas from flue gas analysis of a powdered fuel boiler. With such conditions as these, or approaching them, increased evaporation may be expected, and is in fact obtained, over that from the same fuel burned on grates with a necessarily large excess of air. With powdered fuel there are no clinkers and the ash is apparently as fine as the powdered coal and it may be removed through pipes.

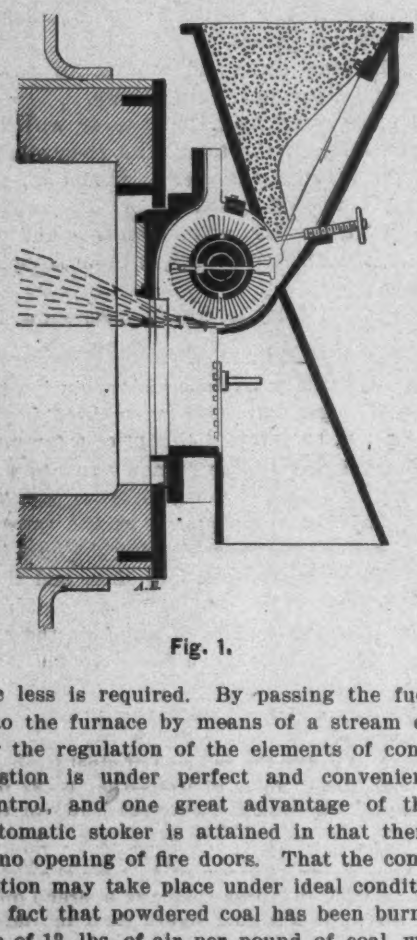


Fig. 1.

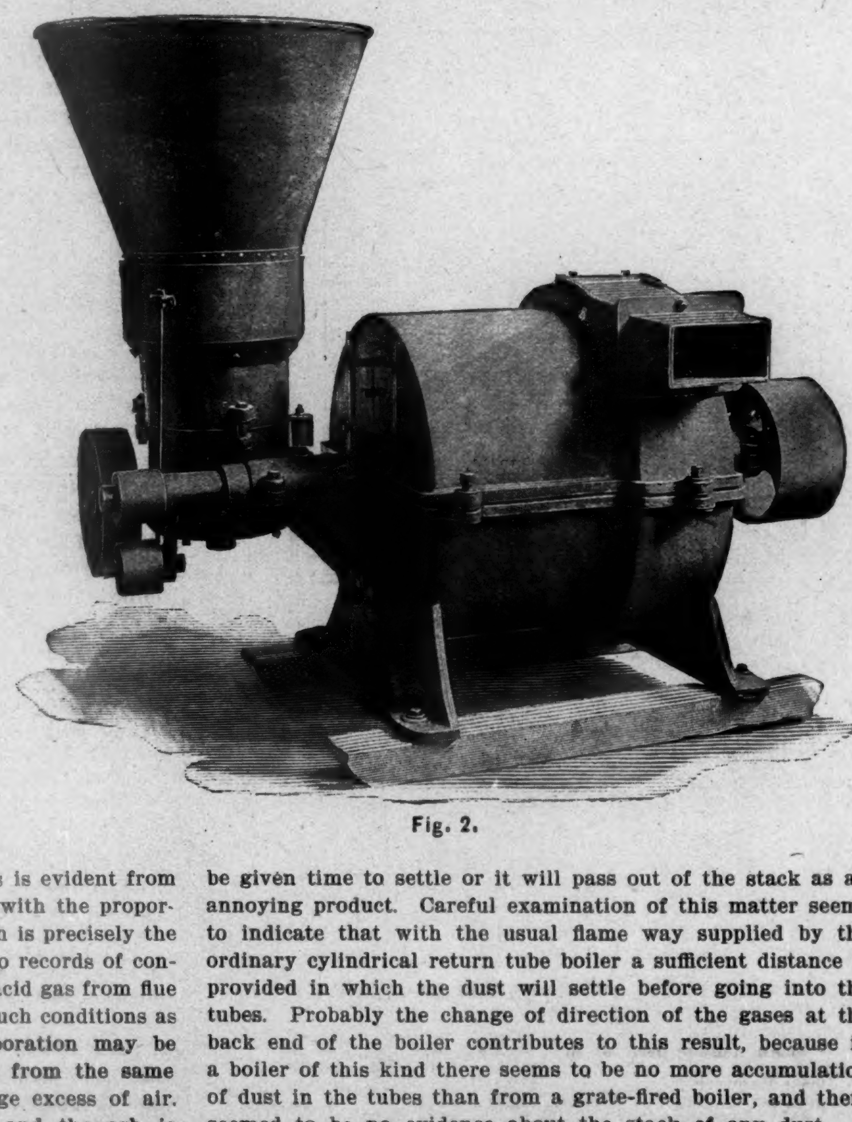


Fig. 2.

Assurance is given that lignite will work satisfactorily when pulverized, although there are no authenticated records at hand confirming it. We have seen the fact demonstrated that very poor coal, works almost as well in this process as better coal when the conditions are adjusted as they should be. There seems to be no difficulty in igniting the powdered fuel, and while it is convenient to retain the ordinary grates upon which to start a wood fire, as a preliminary to the dust firing, they are not absolutely necessary and might be removed, but where they are retained in the boiler, the change back to grate firing may be easily and quickly accomplished if for any reason it becomes necessary. As to reliability, one experimenter informs us that he has operated a stationary boiler with powdered fuel, continuously night and day for four months, without any difficulty.

In looking for the disadvantages, two come to the front and both seem possible to overcome. First, there is the cost of grinding the coal, but this may be safely figured at 25 cents per ton or less, although several early experiments were terminated on account of the expense of this part of the process. With one type of grinder now in use one horse-power is said to be sufficient to grind 100 lbs. of coal per hour. The fineness of grinding differs among the different systems and ranges from 200 mesh to impalpable powder. Formerly great difficulty was found in grinding moist coal, but this has apparently been overcome. Second, after the completion of the combustion the ash is left floating in the gases and it must be given time to settle or it will pass out of the stack as an annoying product. Careful examination of this matter seems to indicate that with the usual flame way supplied by the ordinary cylindrical return tube boiler a sufficient distance is provided in which the dust will settle before going into the tubes. Probably the change of direction of the gases at the back end of the boiler contributes to this result, because in a boiler of this kind there seems to be no more accumulation of dust in the tubes than from a grate-fired boiler, and there seemed to be no evidence about the stack of any dust. It is believed that there need be no difficulty from the ash in this type of boiler, but what the experience with locomotive or marine firing may be is yet to be learned. It has been tried in both of these services, but thus far no demonstrations have been made of its complete success in either.

The fundamental principles for the successful use of powdered coal seem to be (1) a combustion chamber maintained at a high temperature, which requires a fire brick arch to prevent the flame from impinging at once against the heat-

Results of Trials—By Bryan Donkin.

Trial.		
Experimental number	I.	II.
Date of experiment, 1895	March 29.	April 1.
Conditions, with or without Wegener's apparatus	Without	With
Duration of trial, continuous, hours	7.1	6.66
Weather	Wet	Fine and dry
Mean steam pressure (from tested Bourdon gage every quarter hour), lb	82	83.4
Coal.		
Total coal burned, lb	1,600	1,410
Coal burned per hour, lb	225	211.5
Coal burned per hour per sq. ft. of fire-grate, lb	16.3	....
Moisture in coal, per cent	9.0	1.2
Ashes and clinkers in coal, per cent	14.8	Assumed at 15 to 19
Water.		
Mean temperature of feed water entering Boiler, Fah	63°	48.2°
Total feed water evaporated, lb	7,928	10,517
Water evaporated per hour, lb	1,117	1,577
Water evaporated per hour per sq. ft. heating surface lb	2.23	3.15
Evaporation.		
Lb. water evaporated per lb. wet coal, from temperature of feed, lb	4.956	7.46
Lb. water evaporated per lb. wet coal, from and at 212 deg. Fah., lb	5.90	9.00
Lb. water evaporated per lb. dry coal, from and at 212 deg. Fah., lb	6.48	9.11
Caloric value of coal, lb. water per lb. dry coal, from and at 212 deg. Fah., lb	12.00	11.85
Thermal efficiency of boiler = $\frac{\text{actual evaporation}}{\text{caloric value}}$, per cent	54	77
Chimney and gases.		
Mean position of damper	Full open	Full open
Temperature of furnace gases at end of boiler tube, Fah	above 750°	above 750°
Temperature of furnace gases at base of chimney, Fah	438°	413°
Draft of chimney in side flue at front of boiler, inches of water	0.41 in.	Water gage oscillated from a slight pressure to a vacum.
Draught of chimney at base of chimney, inches of water	0 6 in.	
Mean analysis of furnace gases, taken every quarter hour: CO_2 p. c. by vol.	8.72	15.35
O " "	8 13	3.14
CO " "	0.88	0.0
Temperature of air in boiler house, Fah	54°	58°
Smoke.		
Total number of times smoke observed	70	7
Total duration of smoke, minutes	105	6
Mean intensity of smoke (Mr. D. K. Clark's smoke scale), number	7	5

In this experiment the bars were rather too wide apart for the small coal used to get the best results.

ing surfaces; (2) the powdered fuel must be thoroughly mixed with the entering air, so that the air will surround the particles of coal and the fuel must be delivered in an uninterrupted stream; (3) the particles of fuel must be maintained suspended in the gases until they are completely burned, and this requires a somewhat long flame-way, for the flame must not be chilled.

When the coal is finely divided and delivered uniformly mixed with air a solid radiating flame is produced, which at first is full of particles of solid fuel in incandescence, and these rapidly disappear, leaving the larger portion of the flame merely that of burning gas. One has only to follow this flame, as the writer has done, by means of peep-holes arranged through the brick-work of an ordinary boiler setting, to be impressed with the completeness and ideal character of the combustion. The flame is that of gas rather than oil. The fuel appears to be gasified in an intensely hot atmosphere containing the right proportion of the supporter of combustion.

Different systems handle the pulverization differently. The Germans prefer to powder the coal in one place and deliver to the feeding machine in bags, while in this country the neater and safer process of pulverizing the coal as it is used is generally followed. A large amount of finely powdered coal may or may not be dangerous in storage, but there seems to be a decided advantage in carrying the dust directly from the pulverizer into the furnace, because this permits of the most perfect aeration, and this is essential. The power for grinding is applied in various ways, either by belt driving from a small steam engine or by connecting a steam turbine directly to the grinder. The grinding is usually in two stages, the first bringing the coal to about the size of split peas and the second completing the process. The fine grinding seems to be accomplished best by attrition in a cylinder filled with rapidly revolving vanes, and from this cylinder a blower takes the dust into the furnace through a tuyere, which is filled with partitions parallel to the current for the sake of obtaining the uniform mixture and for spreading and concentrating the delivery as desired.

At least four different systems seem to be giving promising and, we may say, satisfactory results. Of these the Wegener process has made considerable headway in Germany and in England. This process was described and illustrated in this journal in July, 1896. The results of trials made on a Cornish boiler by Mr. Bryan Donkin at that time are reproduced in the accompanying table.

In the Wegener process the powdered coal is delivered to the feeder in sacks. The fire doors and ash pit openings at the front of the boiler are closed and the natural draft of the chimney is used to deliver the coal dust to the furnace through a large duct, over which the dust hopper is mounted. In the duct is an air turbine driven by the natural air draft,

Fig. 3.

and this operates a revolving sieve and a tapper whereby the dust is shaken down into the stream of air, by which it is carried into the furnace. The results of the trials indicate a decided superiority of the dust fuel over the same coal burned upon a grate a few days before in the same boiler. No extraordinary performance is claimed for the Wegener process, but this test would indicate that its commercial advantages depend largely upon the cost of powdering the coal. As far as smoke is concerned, it is perfectly satisfactory.

Another German process, the Schwarzkopff, is particularly interesting just now, because of experiments which are being conducted with it by Mr. Wm. Renshaw, Superintendent of Machinery of the Illinois Central, upon one of the furnaces at the 14th Street Power House of that road in Chicago. The plan of this device is shown in the accompanying engraving, Fig. 1. Mr. Renshaw is not ready to express an opinion pending the results of tests which are now under way, but he evidently considers that there is something in the process and promises the results when the tests are completed.

The Schwarzkopff feeder is attached to the furnace front and consists of a hopper containing the pulverized coal, a rapidly revolving brush to feed the coal through an opening into the furnace, and an air opening for the control of the air. The regulation of the delivery of the fuel is had by the

small hand wheel which controls the opening through which the dust passes to the brush.

The Ideal Fuel-Feeder Company, 164 Montague Street, Brooklyn, have been engaged for several years in developing a pulverized coal system, and the writer recently examined it as applied to a cylindrical return tube boiler in commercial operation in Brooklyn and was impressed with the whole idea, as no one can fail to be who will take the trouble to investigate it.

The boiler is of 90 nominal horse-power and supplies steam at 80 lbs. pressure. The stack temperature is about 400 degs. The boiler was taken as it stood when used for grate firing, and the machine shown in Fig. 2 was applied as indicated in Fig. 3. A small vertical stationary engine and a belt to the pulverizer completed the equipment and a return to grate firing may be made in five minutes, plus the time required to start the grate fire. After watching the stack for two hours we can say that the combustion is absolutely smokeless as regards black smoke. There was at times a light-gray mist near the stack, but less in amount and of about the character of the whitish haze from a stack of a coke fire. Prof. D. S. Jacobus, after a test, says of it: "At times there was no smoke visible at the stack, and the smoke which did appear under some conditions of the fire was of a very light character, being in the nature of a gray mist extending but a few feet from the chimney. When working under proper conditions there was little or no smoke produced."

On the day of our inspection Clearfield bituminous coal was used, which has about 75 per cent. fixed carbon and 20 per cent. of volatile matter. The crusher and pulverizer require about six horse-power, but this machine has a range of capacity from 200 to 900 lbs. of coal per hour, which is hardly a fair test of the power consumed by the pulverizer, because its capacity is much greater than that of this boiler. A glance at the engravings will show that the machine is in three parts, the grinder, the pulverizer and the blower. The success of this system seems to be chiefly in the satisfactory aeration of the fuel, and its uniform delivery. Experiments are now being undertaken to determine the possibility of firing several boilers from one machine, and if the dust can be delivered uniformly to several furnaces a long step in the direction of practical application to boiler plants will have been taken. It is also the intention to apply it to locomotive and marine practice, where a wide field awaits a successful system. We have records of evaporative tests with Clearfield coal, showing 10.48 lbs. of water per pound of coal, the feed water being at 72 deg. F. The same coal has given about 6 lbs. on the grates of this boiler.

The efficient lighting of freight yards at night is a difficult problem, and one which has as yet been solved in but few cases. Good lighting is most desirable to facilitate the work of carding the cars and carrying on the various switching movements, but the conditions are very unfavorable. Electric lighting is in many ways the most satisfactory, but great care needs to be taken in placing arc lights so as to avoid long shadows as far as possible. This means the use of very tall poles. With lights badly set, the alternations of patches of bright light and moving shadows of intense blackness (by contrast) are probably more dangerous than a uniform darkness to which the men's eyes become more or less accustomed. The writer has in mind a case where the electric light was introduced in a dock shed formerly lighted by gas jets and hand lamps. The general effect was surprising; the whole shed seemed to be light. The intense shadows, however, were at first a great source of annoyance to the men trucking loads, and when they began to get used to them, several accidents occurred through men stepping off the edge of the dock in the shadows. As a result, the entire arrangement of the arc lamps had to be changed, by placing the lamps as high as possible and so distributing them as to prevent the long and intensely black shadows which existed under the original arrangement.—E. E. R. Tratman, Western Railway Club.

FAST RUNS ON THE LEHIGH VALLEY.

Black Diamond Express.

During the period from October, 1897, to July last, the "Black Diamond" express of the Lehigh Valley has made a number of fast runs which have been tabulated by the passenger department and are reproduced in the accompanying table:

FAST RUNS MADE ON LEHIGH VALLEY RAILROAD.

Distances Over 100 Miles.

Train.	Date.	From	To	Dist.	Actual time, mins.	Speed per hour.
9	July 20, 1898.	Sayre	Buffalo	177	169	63
9	July 24, 1899.	Sayre	Buffalo	177	170	62

Distances 50 to 100 Miles.

Train.	Date.	From	To	Dist.	Actual time, mins.	Speed per hour.
10	Oct. 11, 1897.	Easton	So. Plainfield	50.4	48	64
10	Oct. 16,	Easton	Parkview	65.6	60	66
10	June 6, 1898.	Easton	Parkview	65.6	61	62
9	Jan. 9, 1899.	Manchester	Buffalo	88	86	61
9	Mar. 22,	Manchester	Buffalo	88	85	62
10	Mar. 23,	Buffalo	Manchester	88	83	64
10	Nov. 2,	Wende	Manchester	69	61	65

Distances Under 50 Miles.

Train.	Date.	From	To	Dist.	Actual time, mins.	Speed per hour.
9	May 15, 1899.	So. Somerville	Landsdown	19.5	16	73
9	May 20,	Laceyville	Rummerfield	18.9	14	82
10	June 24,	Wysox	Wyalusing	16.8	14	73
9	July 18,	Laceyville	Wysox	26	22	72
9	Aug. 19,	Laceyville	Homet's Ferry	15	12	75
10	Oct. 13,	Rummerfield	Laceyville	18.9	15	76
9	Nov. 3,	Alpine	Geneva Jct.	43.9	33	80
9	Feb. 12, 1900.	Hinman,	Geneva Jct	44.9	37	73
9	Feb. 19,	Alpine	Kendaia	34	25	82
9	Mar. 22,	Batavia	Depew Jct	27.5	23	70
10	July 3,	Homet's Ferry	Laceyville	15	12	75
9	July 21,	Alpine	Kendaia	34	23	89
10	Oct. 5, 1897.	Musconetcong.	Three Bridges	15.4	12	77
10	Oct. 9,	Three Bridges.	Bound Brook	.15.5	11	85
10	Oct. 13,	Homet's Ferry	Laceyville	15	11	82
9	Oct. 16,	Wyalusing	Wysox	16.8	13	78
9	Oct. 18,	Pt. Reading.	Landsdown	21.9	18	71
10	Oct. 21,	Musconetcong	Bound Brook	30.9	26	71
9	Nov. 1.	Wyalusing	Wysox	16.8	14	72
9	Nov. 11,	Hector	Kendaia	17.6	12	88
10	Dec. 11,	Towanda	Laceyville	30	25	72
9	June 9, 1898.	Parkview	So. Plainfield	15.2	14	66
10	Jan. 13,	Musconetcong	Three Rivers	15.4	13	68
9	Aug. 6,	So. Somerville.	Landsdown	19.5	17	69
9	Aug. 9,	Parkview	So. Plainfield	15.2	13	70
10	Aug. 31,	So. Plainfield	Parkview	15.2	13	70
9	Oct. 3,	Burdett	Kendaia	22.9	17	82
9	Oct 17,	Alpine	Kendaia	34	26	79
9	Dec. 16,	Laceyville	Rummerfield	18.9	15	76

The regular schedule of this train is, westbound, New York to Buffalo, 448 miles, 9 hours and 55 minutes, including the ferry and 13 stops. Deducting time consumed by the ferry and stops, the actual running time of the train between Jersey City and Buffalo, 447 miles, is 9 hours and 12 minutes.

The regular schedule of the train, eastbound, Buffalo to New York, 448 miles, is 10 hours and 3 minutes, including ferry and 13 stops. Deducting the time consumed by ferry and stops, the actual running time of the train between Buffalo and Jersey City, 447 hours, is 9 hours and 20 minutes.

Especial attention is called to the fast run made by train No. 9 on July 21, 1900, Alpine to Kendaia, a distance of 34 miles in 23 minutes, or a speed of 89 miles per hour. Another instance is shown on November 3, 1899, where train No. 9 ran 43.9 miles in 33 minutes, this being 80 miles an hour.

It is understood that these figures are taken from the train sheet records.

The first of the new Monitors, the "Arkansas," was launched at Newport News, November 10. These vessels will have a single balanced turret forward, with 9 in. of steel armor and equipped with two of the new type 12-in. guns. They will also have four 4-in. rapid-fire guns, three 6-pounders, and four 1-pounders.

AIR BRAKE HOSE SPECIFICATIONS.

Belgian and French Railroads.

In connection with the discussion on brakes and couplings before the International Railway Congress, Mr. J. Doyen, Engineer of the Belgian State Railways,* presented some of the details of foreign practice with regard to air-brake hose which will interest our readers who have been concerned by the great expense of hose maintenance. Mr. Doyen speaks of the hose as being mainly responsible for the maintenance charges of the brakes. Many foreign roads have adopted hemp coverings to protect the hose, and the French Northern has increased the life of the hose 50 per cent. by varnishing and tarring it before applying the covering. Mr. Doyen concludes his paper with extracts from the specifications of several roads which we reproduce from the record.

The Belgian State Railways specify as follows: The density of the rubber shall be at least 1.10 and it shall be vulcanized by means of sulphide of antimony. The rubber shall, without losing its qualities, support a dry heat of 266 deg. Fahr. for one hour, and a moist heat of 320 deg. Fahr. for three hours; it shall leave when burnt 42 to 45 per cent. of ash composed of equal parts of oxide of lead (litharge) and oxide of zinc. The canvas used in making the tubes shall be up to sample. The tubes must be capable of being placed without tearing on a mandrel the maximum diameter of which is 1⅜ in. for tubes the interior diameter of which is 1 1/16 in., and 1⅝ in. for those of 1¼ in. diameter. Tubes of 1 1/16 in. interior diameter are made with four layers of cotton canvas, those of 1¼ in. with five layers. The tubes must be provided at each end with a ring of rubber 2/25 to 3/19 in. thick; plunged in water and filled with air at a pressure of ten atmospheres they must not deteriorate and no air bubbles must escape. The tubes are to be guaranteed for two years and a half.

On the French Eastern Railway the pressure test is limited to 7 kilograms per square centimeter (99.6 lbs. per square inch), and the tubes are guaranteed for two years.

The French Southern requires special tests. A sample of the rubber reduced to small pieces and heated in a drying oven to 275 deg. Fahr. for six hours, must remain elastic, and must not become brittle or alter its properties. Another sample placed in chlorine at 68 deg. Fahr. for twenty-four hours must not harden or crack on the surface. A third sample must not crack or change its shape if heated for an hour to 248 deg. Fahr. in the mineral oil called "Mazout." The proportion of mineral matter and ash contained in the rubber must not be greater than 45 per cent. Under the action of a solution of caustic soda in alcohol, the rubber must not lose more than 15 per cent. of the weight of pure rubber it contains. Washed afterward in nitrobenzene the loss must not be more than 35 per cent. of the same weight of pure rubber. These tests are to be carried out as follows:

One gram of shredded rubber is to be digested for an hour at boiling point in a flask fitted with a return condenser with a mixture of 4 cubic centimeters (0.244 cubic inch) of pure soda lye at 36 deg. Baume and 17 cubic centimeters (1.037 cu. in.) of 95 per cent. alcohol. The solid matter left is to be washed with boiling water, until the washing water is neutral, then collected on a weighed filter and dried at 100 deg. C. (212 deg. Fahr.) until the weight is constant. The weight of dry matter remaining, subtracted from one gram, will give the required loss of weight.

Let c be the percentage of ash, F the loss of weight (in centigrams) found above. Then the loss as a percentage of the weight of pure rubber will be given by the expression:

$$F \frac{100}{100 - c}$$

*Bulletin, International Railway Congress, July, 1900, page 2,175.

The insoluble residue obtained above is then to be digested for about an hour at about 20 deg. C. (68 deg. Fahr.) with 30 cubic centimeters (1.831 in.) of nitrobenzene, then filtered and washed, first with 30 cubic centimeters of nitrobenzene and then with 100 centimeters (6.103 cu. in.) of 95 per cent. alcohol. The residue is then to be dried at 100 deg. C. (212 deg. Fahr.) until the smell of nitrobenzene has disappeared.

Let A be the new loss of weight (in centigrams) thus found, then the loss due to nitrobenzene, taken as a percentage of the pure rubber, will be given by the expression:

$$A \frac{100}{100 - c}$$

The Paris-Orleans Company requires that the tubes should stand an interior pressure of 30 kilograms per square centimeter (426.7 lbs. per square inch) without permanent stretch. They must be capable of being bent to a radius of 100 millimeters (4 ins.) throughout their length, without breaking or flattening.

On the Paris-Lyons and Mediterranean Railway the tubes are in the first place slipped on to the connecting pieces, which have been painted with rubber solution. It must be possible to do this without the use of a mandrel to stretch the tube, and without tearing or stripping the rubber. The tubes having thus been provided with a metallic coupling piece at each end, are fixed to these coupling pieces by means of metal bands drawn up by a screw. They are then tested for leakage at a pressure of 10 kilograms per square centimeter (142.2 lbs. per square in.). At this pressure the increase in exterior diameter must not be more than 4 millimeters (3/19 in.). A certain number of tubes from each batch are tested for bending as described hereafter, which, filled with air at a pressure of 8 kilograms per square centimeter (113.8 lbs. per square inch), they are then tested again for leakage at a pressure of 10 kilograms per square centimeter (142.2 lbs. per square inch). For the bending tests each tube, with its coupling pieces, is put in a special machine, which reproduces as nearly as possible, by means of oscillations of 200 millimeters (8 ins.) amplitude, the deformation which the tubes undergo in practice on the coaches. The tubes are subjected to a series of 20,000 oscillations, with an interior pressure of 8 kilograms per square centimeter (113.8 lbs. per square inch). If the oscillation tests reveal no defect, and if during these tests the metallic coupling pieces at the ends of the tubes are not displaced, the tubes undergo the second leakage test at 10 kilograms (142.2 lbs. per square inch) pressure as mentioned above.

In discussing the problem of securing adequate freight house facilities in very crowded districts, in a paper before the Western Railway Club, Mr. E. E. R. Tratman expresses the opinion that there are already cases where economy would well warrant the installation of tracks on two floors, the cost of land being greater than that of the additional building and equipment. Mr. E. P. Dawley, of the New York, New Haven & Hartford Railroad, states that $2 per square foot extra, above the cost of a one-story house, ought to give a good mill-construction, slow-burning type of building two stories high. The arrangement would be easily established on a side-hill location, but could also be established in flat localities with comparatively little additional expense, and prove a profitable and economical investment. Coaling stations quite frequently have approaches of 5 to 6 per cent., or even 10 per cent., for the loaded coal cars, which are pushed up by a small dummy car on the end of a cable, or by other suitable means. At coaling piers, etc., the loaded cars—with 39 to 50 tons of coal—are sometimes hauled up inclines of 25 per cent. to the top of the pier by cables. Similar methods could be used for the freight houses, and if the low-level tracks were depressed 4 or 5 ft., the incline approach to the high level would be quite short.

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Contributions.—*Articles relating to railway rolling stock construction and management and kindred topics, by those who are practically acquainted with these subjects, are specially desired. Also early notices of official changes, and additions of new equipment for the road or the shop, by purchase or construction.*

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The satisfying results of awarding prizes in manufacturing plants to men who suggest the most valuable improvements and the steady increase in the practice raise the question whether the idea is not equally applicable in railroad shops. If a superintendent of motive power should be authorized to offer to the shopmen several prizes, varying from perhaps $100 to $25, to be awarded annually for the suggestions which lead to the greatest amount of saving in cost of the work, it is probable that the investment would pay handsomely, as it does in other large establishments. In a thousand workmen such as are found in locomotive and car works there must always be many bright, intelligent men whose interest might be enlisted in this way.

The locomotive of to-day is a noble production, and we are in hearty sympathy with every effort toward symmetry and beauty in design. Americans are accused of building locomotives which have the appearance of being "blasted out of the solid rock," in the pursuit of simplicity, and this in many cases amounts to an utter disregard of appearances which seems unnecessarily severe. In a recent address before the students of Purdue University, Mr. Waldo H. Marshall, of the Lake Shore, defined the conditions in working up a design as (1) Safety; (2) Efficiency and reliability in service; (3) Economy, and (4) Beauty of the whole design. Upon the last point he expressed a high and worthy ideal when he said: "The modern locomotive, with its mammoth proportions and simple outlines, its great boiler indicative of power, and its well proportioned machinery is altogether too magnificent and majestic a piece of work to leave the hands of the designer in a crude and unfinished state. A handsome locomotive hauling at high speed and apparently with so much ease a long passenger train or dragging with slower motions many hundreds of tons of freight, is a sight which pays the designer for all of his labor, and if we reflect upon the great work which the locomotive is doing, and will yet do, for mankind in the development of the resources of nations, and the extension of the bounds of civilization, we find inspiration for careful, conscientious work in the assurance that whatever can be contributed to the perfection of the locomotive is worth the best efforts of the mechanical engineer."

THE STAYBOLT PROBLEM

In the matter of staybolts one of two things is certain. They should be made so that they will not break or locomotive boilers should be so constructed that staybolts will not be necessary. Both are possible, and the exigencies of present service demand a decided step away from present practice, which is giving so much trouble. Delays to engines because of inspection and necessary replacements of broken bolts and the cost of present methods are becoming sufficiently important to demand radical treatment without consideration of the question of safety at all.

The extent of the effect of the advent of the wide firebox on this question is uncertain. It is expected to lead to an improvement, and such a plan as Mr. Gaines presents elsewhere in this issue will probably tend in the same direction. These, however they may affect the future, cannot help matters with the 35,000 or so narrow fireboxes in use in all parts of the country. These constitute a problem by themselves, and it is highly desirable that a remedy should be found to meet the needs of these, and also new fireboxes, in the same way.

Enough is known of the peculiar relative movements of the inside and outside firebox sheets to show the necessity for flexibility in the staying, and it has been said that, if the ends could be properly secured in the sheets, wire rope stays would be ideal. Perhaps they would, but it is now believed to be doubtful whether the typical sling stay so long used for crown sheets would not be even better, because it permits of a slight approach of the sheets toward each other. This is held to be a necessary feature by one who has experimented with staybolts and stuffing boxes to measure these movements. Mr. J. B. Barnes, Superintendent of Motive Power of the Wabash Railroad, has kindly enabled us to illustrate and describe in this issue an important improvement in staybolts which he has devised after an experience of thirty-five years, and he has taken a great deal of trouble to give us a thorough description. He believes this design to fully meet the needs, and furthermore says:

"We have removed and replaced in the fireboxes of 30 of our high-pressure engines between January 1 and September 1, 1900, 3,100 staybolts of ordinary design, and we use in staybolts of our make the best material we can get for the purpose. On a road with large and closely assigned equipment the aggregate detention to engines on account of renewals of staybolts is a very important and expensive item. Taking engines out of service for this purpose and substituting others interferes with traffic and takes time which is very valuable, in addition to the large expense of repairs."

In previous issues* we have endeavored to inform our readers of progress in staybolts. At present a flexible connection with the outer sheet seems to be the most promising factor. These bolts will cost more than ordinary ones to instal, but if they do not break, the expense is justified. We do not believe that present common practice in staybolts will be perpetuated or even defended much longer.

*American Engineer and Railroad Journal, September, 1897, page 319; December, 1899, page 382; and January, 1900, page 3.

CORROSION OF STEEL CARS.

Apparently Not a Cause for Anxiety.

If cars made entirely of steel are to have short lives because of corrosion, it is important to know it, because of the numbers which are being built. We considered the subject sufficiently important to secure an expression of opinion from a railroad mechanical officer whom we consider the best authority to be had. His experience covers the period of a little more than two years since the beginning of large orders for steel coal cars, and he finds no evidence that they are being injured by corrosion. He does not say that there has been no corrosion at all, for in the case of a small number of cars which stood on a side track loaded with soft coal for 90 days, some of the hopper plates and door fixtures were corroded, but not more than was to be expected. In fact, as much trouble has been experienced with wooden cars under similar conditions. Sometimes the door fixtures and truss rods of wooden cars have suffered; also the trucks and even the rails. This officer, who, for obvious reasons, does not wish his name used, believes that his experience has been long enough, and we know it has been wide enough, to develop the weakness if it exists. His opinion is reassuring.

In France (see the American Engineer, Vol. LXX., page 171, 1896) Mr. Tolmer, in 1896, found that steel frame cars showed the following proportional losses in section from corrosion and rust:

Cars built in	Life.	Loss in per cent
1869	27 years	6.0
1874	22 years	4.0
1875	21 years	3.18

In the same year, 1896, Mr. E. M. Herr, then Assistant Superintendent Motive Power of the Chicago & Northwestern, found that iron locomotive tender frames showed a waste of from 10 to 15 per cent. in section in service varying from 9 to 17 years, the exposure to the weather being noticeably severe upon them, and the use of paint almost wholly neglected. Mr. Tolmer recommends painting steel cars every three years and if this is carefully done the structures are expected to last from 40 to 60 years in France, which is long enough for any part of railroad equipment to become obsolete several times over. Locomotive tenders are subjected to infinitely more severe service than that of coal cars, and there has never been a question of what material should be used for their construction. Neither is wood considered as a better material for the coal space of tenders. If a steel car is thoroughly painted every three years the life of the understructure will be indefinite and, except for repairs due to wrecks, there should be a little expense required, probably much less than with wooden cars. The cost of repairs to a wooden car averages about $40 per year (Interstate Commerce Commission Statistics), and it is probable that this amount per year will be more than enough to keep steel cars in good condition for several times the life of wooden structures. It has been pretty well established that with wooden cars the repair expense may be divided as follows: Body, 36 per cent.; trucks, 32 per cent.; draft gear, 32 per cent. The trucks and draft gear being common to both, will balance each other, and there remains a steel car body to be maintained against a wooden one for 36 per cent. of the total cost of repairs. It is reasonable at least to expect this ratio to be maintained, and it is probable that the total cost will not be increased by the steel cars in spite of the fact that they carry more freight and are generally used more continuously than the wooden cars.

It is important to design steel cars to prevent the bending or "working" of the plates near the joints because of the opportunity for corrosion which such bending offers. The draft gear question is also important, and much more so as the capacities increase. Those ordering large steel cars, or large capacity cars of any type, should take up this question carefully or their draft gear troubles will enormously increase.

Summed up in a few words, the situation seems to warrant this conclusion: That steel cars, or any other cars, should not be used for the storage of soft coal, for any length of time, particularly where exposed to the weather; steel cars should be painted thoroughly and often enough; the draft gear should be adequate to meet the demands upon it, and if these precautions are taken steel cars ought to be practically indestructible, or at least as much so as steel bridges; that is to say, they will outlive their usefulness.

THE DEPTH OF WIDE FIREBOXES.

In heralding the advent of the wide firebox for soft coal burning, in the November number, we have been taken to task concerning the omission of a consideration of the depth of the firebox. A correspondent who is securing most satisfactory results with wide fireboxes and is enthusiastic in their praise, fears that in the desire to secure adequate grate area the importance of depth in the firebox will be neglected. He insists that, for soft coal, the firebox should be both wide and deep, and he is probably entirely correct, because there appears to be every reason to believe that the more combustion space, within the limitations of the locomotive, the better. But we believe that the wide grate has so much to offer in the way of improvement that the gain due to width is greater than that to be obtained from depth. If both cannot be had, it will probably be found best to get the width at a considerable sacrifice of depth. We have particularly in mind the six-coupled engine for fast and heavy passenger service, to which it is difficult to apply a wide firebox without making it very shallow. A six-coupled engine is a necessity upon roads having fast, heavy trains making frequent stops, and it is this type which seems to offer the difficulties, and it is relatively easy to secure deep fireboxes with the Atlantic type wheel arrangement. If it is possible to use a wide and shallow box over very large driving wheels the powerful passenger engine will be easy to design.

Another correspondent supports the wide and deep box. He says: "There is a distinct difference between the wide, shallow firebox, as a type, and the wide, deep firebox. The wide, shallow firebox over the driving wheels is certainly not new, but it does not seem to be well suited to bituminous coal, which comes from the mines in sizes varying from very large to very small pieces."

A Western motive power officer in commenting upon the article referred to, "Emancipation of the Grates," says: "I am firmly convinced that in high-power modern engines, up to the present time, sufficient grate area and firebox volume have not been furnished. It will be necessary to adapt the amount of grate area to the fuel, which, as stated in the article, can be accomplished by means of large areas and of dead plates, if necessary to reduce the area, and where it is necessary to use dead plates it will be rather an advantage instead of a disadvantage in that the firebox volume will be large. This will furnish an excellent combustion chamber. I think that all of the advantages of the larger grate area set forth in this article will be realized."

This gentleman is not troubled about the depth of the firebox. He says: "A reduction in depth will come with the use of wider fireboxes in some types of engines, but this, I think, will be offset by the many advantages."

A superintendent of motive power who has just ordered a number of consolidation engines with wide fireboxes, recently wrote: "I agree entirely with your views on the subject, as is evidenced by the fact that we are now having a number of heavy consolidation engines built with wide fireboxes giving nearly 50 sq. ft. of grate area. The recent experiments with the C. & N. W. engine seem to demonstrate beyond argument the possibilities of economy inherent in the design. The only adverse condition which should be apprehended is in the case of engines whose service requires them to stand under steam for a large part of the time with a correspondingly small time of active work. Under such conditions it may be more eco-

nomical to burn fuel at high rates of combustion during the relatively brief period of maximum work, in order to avoid excessive standing losses.

"To the motive power official one of the most attractive features of the wide grate is the possession of engines which may be depended on to steam freely with any grade of fuel. There can be few such who have not been at times exasperated by the constant reports of trains delayed by low steam, due to poor coal. Lack of uniformity in quality of fuel is a condition which must be accepted and faced, and the large grate is at present the most hopeful solution of the problem.

"The most interesting question as to the development of the type is in regard to the practicability of designing heavy freight engines in which high tractive power requires a large percentage of total weight to be carried on the driving wheels. In such designs, trailing wheels are out of the question, and careful design is needed to reach the most harmonious adjustment of parts, since a sufficient depth of firebox must be obtained without raising the boiler excessively, and at the same time the firebox must be elevated above the drivers. That the problem is not incapable of solution is demonstrated. by several recent designs, as to the success of which I believe there is little room for doubt. I think your article an excellent one. You have not stated the matter at all too strongly."

Another who has ordered a large number of wide-firebox engines says: "I think you have covered the subject in an admirable manner. I indorse every word of your article on wide grates. The wide firebox and large grate surface for bituminous coal have come to stay, I believe, and I believe that they will give opportunities for increased capacity of locomotives in passenger and freight service."

The effect of depth of firebox upon combustion is now chiefly a matter of opinion and the subject needs investigation. To secure ideal firebox conditions the depth, as well as the area, needs to be made to fit the coal. Anthracite, with its short flame, requires comparatively little combustion space, while all long-flaming fuels require more. If coals could always be selected, those high in fixed carbon would be favorites because the heat would be developed close to the fire, and the heat developed near the fire has a longer journey before becoming cold by contact with the tubes.

The three coals in the following list evidently require rather different firebox conditions:

	Fixed carbon.	Volatiles.
Pocahontas	75%	18%
Hocking Valley	46%	36%
Streator	44%	39%

Such wide differences in fuels support the contention that each superintendent of motive power will need to study the special conditions which he has to meet. It is reasonable to suppose that Streator and Pocahontas should not be expected to give equally good results in the same firebox. The former requires greater depth. We believe that the best development of the firebox and combustion is only begun and that there is more improvement to be had from this than from any other factor of locomotive design. Its importance is twofold, because greater efficiency of combustion means saving of money and also increase of capacity of the locomotive, which will amount, in the end, to the same thing.

TIGHT TRAIN PIPES AND UNIFORM PISTON TRAVEL.

Two Air Brake Factors Requiring Attention.

The writer recently examined a recording gauge diagram from the train pipe of a 30-car train, of air-braked cars, which showed a 35 minute struggle of the air pump, an old and small one, to charge the train reservoirs after a rather severe application. A larger pump would have reduced the time, but the chief trouble seemed to be in a large number of small leaks in the train pipe and couplings. There are two good reasons for investigating and remedying such conditions, first, on account of the impaired efficiency of the brakes, and, second, because of the drain on the locomotive boiler to drive the air pump. Messrs. Petrie and Sheldon spoke plainly on this subject before the Railroad Club in Buffalo last month, and indicated a condition of air brakes requiring immediate attention. They stated that with a slight leakage at the couplings, especially if the air pump is not the largest and latest, it is usually necessary to "cut out" air-braked cars in order to get any service. They direct attention to faults with the couplings, and say: "The gaskets are continually wearing out, showing that they should have a larger bearing surface where they come together, or made of a different material, to make a larger surface." They suggest larger couplings or the enlargement of the gasket in the present coupling.

The necessity for economizing in the use of air becomes more important with the increasing number of air-braked cars and the loading of the locomotives up to their full capacity. Also the exacting character of present-day train service demands the utmost of the brake gear. For these reasons the brake-slack adjuster is becoming daily more important. The gentlemen referred to also gave this a high place in the list of necessary improvements. Differences in piston travel cause differences in the force of application of the brakes, and consequently shocks in the train. With long piston travel the brakes are less efficient, because of the greater space behind the piston to be filled with air, and the consequent lower pressure of air secured by a given amount of reduction. Long piston travel wastes air in two ways. A car having a 6-in. piston travel and a train line pressure of 70 lbs. requires a 16-lb. reduction to give a cylinder pressure of 54 lbs. A car with a 9-in. travel requires a reduction of 22 lbs. to give a brake cylinder pressure of only 48 lbs. This may mean a waste of one-third of the air pumped. It is to be overcome by the use of automatic slack adjusters. A satisfactory brake adjuster is available and waiting for those who are ready to invest in it.

LOCOMOTIVE BOILER EXPLOSION.

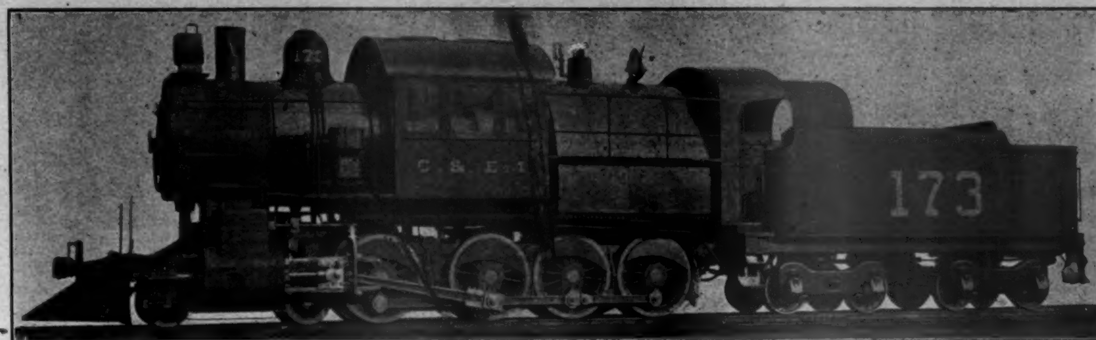
Great Eastern Railway, England.

An interesting boiler explosion which occurred September 25, at Westerfield station on the Great Western Railway, England, is described in "The Engineer" by aid of a number of engravings. The engine, which was nearly new, had just hauled a rather heavy freight train up an incline, and the safety valves, which were set at 160 lbs., were blowing off at the time.

The plates showed no signs of overheating, the staybolts were not broken, and there seemed to be no evidence of poor material. The firebox appears to have given way inside, at the side and below the water level, in fact quite low down; it ripped inward, tearing away from the stays until the crown was reached. At this time the strip torn must have been free from the mud ring, from which it tore away in the solid plate and not through the rivet holes. Eighty-eight of the crown bar bolts were broken. According to the account of the examination, the events appeared to be as follows:

(1) A rent is made in the side of the box, through which water rushes out; (2) the pressure in the boiler being reduced, a portion of the water is flashed into steam; (3) this flashing process being once started, it goes on, until in the twinkling of an eye a pressure is produced great enough to tear up the firebox.

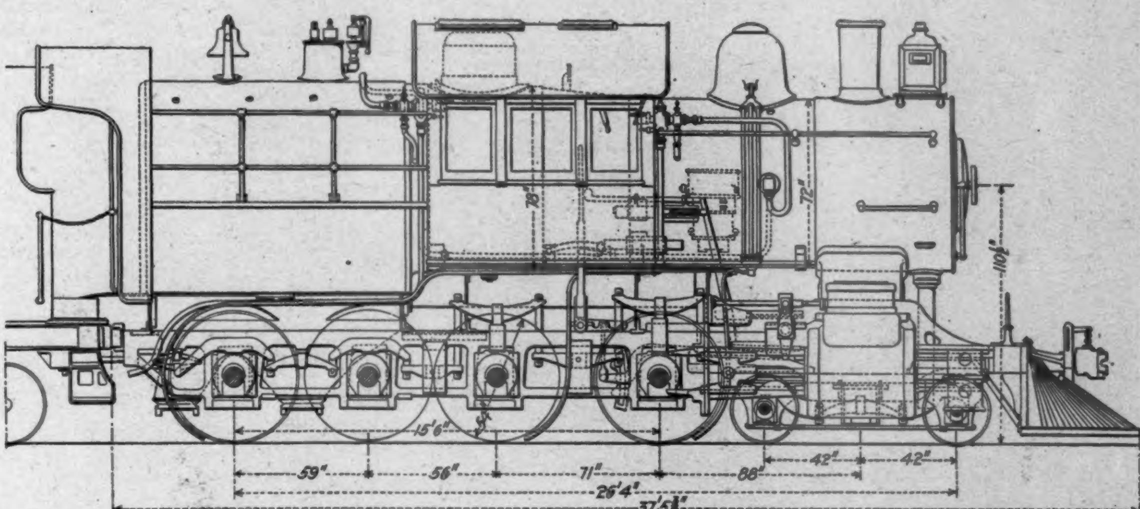
The firebox was of a good quality of copper. It may have been too good; that is to say, so pure that it was too soft, and a cheaper and poorer grade might have held intact. The staybolts were not riveted over at the ends. They were drilled and the threads closed tightly into the sheets by a drift. The fact that many of them pulled through the sheet indicates the probability that it would be better to rivet them. It is difficult to account for the initial fracture of the firebox sheets, and the only reasonable explanation seems to be that the plate pulled away from the staybolts and then the events occurred as already stated.



TWELVE-WHEEL TWO-CYLINDER COMPOUND WITH WIDE FIREBOX.

PITTSBURG LOCOMOTIVE WORKS. CHICAGO & EASTERN ILLINOIS RAILROAD.

Weights: Total of engine............189,700 lbs.; on drivers............150,000 lbs.; total of engine and tender..........287,700 lbs.
Wheel base: Driving............15 ft. 6 in.; total of engine........ 26 ft. 4 in.; total of engine and tender.........51 ft. 2 in.
Cylinders: 21½ and 33x30 in. Wheels: Driving....... 54 in.; truck...... 28 in.; tender........33 in.
Boiler: Diameter .... 72 in.; boiler pressure...............200 lbs.
Firebox: Length...........108 in.; width..............96 in.; depth front.... ....71⅝ in.; back.........59⅝ in.
Grate: Area.... .... 72 sq. ft. Tubes: 300; 2 in., 14 ft. 6 in. long.
Heating surface: Tubes.... .....2,265.6 sq. ft; firebox...... .. 181.4 sq. ft.; total ....2,447 sq. ft.
Tender: Eight-wheel; water capacity............4,500 gals.; coal capacity...........10 tons.



Twelve-Wheel Two-Cylinder Compound, with Wide Firebox—Chicago & Eastern Illinois Railroad.

TWELVE-WHEEL TWO-CYLINDER COMPOUNDS.

With Wide Firebox for Soft Coal.

Chicago & Eastern Illinois Railroad.

The Chicago & Eastern Illinois has just received five locomotives from the Pittsburg Locomotive Works. They are two-cylinder compounds, with a grate area of 72 sq. ft., which is larger than that of recent engines with wide grates for soft coal. The cylinders are 21½ and 33 by 30 in. and the driving wheels 54 ins. in diameter. The grate is 9 ft. long and 8 ft. wide, and, owing to the width, the cab was placed in front of the firebox. The new engines have been running about six weeks, which is too short a time for an estimate of their qualities. These engines have Mr. Wightman's form of cylinder and frame construction which was used on the very large Pittsburgh, Bessemer & Lake Erie engines (American Engineer, July, 1900, page 214, and September, page 280). The frames are of cast steel and special attention was given throughout to their strength and lateral bracing. The brake shoes are behind the wheels. The links are placed as near the forward axle as possible and a motion bar, offset to clear that axle, connects to the rocker arm which is very close to the cylinder. The diagram and photograph make this construction clear. The combination of the wide grates and compounding may be expected to give a good account of itself. The following table gives additional information:

Twelve-Wheel, Two-Cylinder Compound, Chicago & Eastern Illinois Railroad.

Wheel base, total, of engine	26 ft. 4 in.
Wheel base, driving	15 ft. 6 in.
Wheel base, total, engine and tender	51 ft. 2 in.
Weight on drivers	150,000 lbs.
Total weight in working order	189,700 lbs.
Cylinders	21½ and 33 by 30 in.
Driving wheels, diameter	54 in.
Heating surface, firebox	181.4 sq. ft.
Heating surface, tubes	2,265.6 sq. ft.
Heating surface, total	2,447 sq. ft.
Grate area	72 sq. ft.
Boiler diameter	72 in.
Boiler pressure	200 lbs.
Firebox, length and width	9 by 8 ft.
Firebox, depth, front and back	71⅝ and 59⅝ in.
Height, center of boiler above rails	9 ft. 2½ in.
Height of stack above rails	15 ft.
Drivers, material of main centers	Cast steel
Drivers, material of other centers	Steeled cast iron
Truck wheels, diameter	28 in.
Journals, driving axle, size	8½ by 10 in.
Journals, truck axle, size	5½ by 10 in.
Piston rods, diameter	4 in.
Kind of piston-rod packing	Metallic
Steam ports, length	H.-P. 18 in., L.-P. 21 in.
Steam ports, width	H.-P. 1⅜ in., L.-P. 2 in.
Exhaust ports, length	H.-P. 18 in., L.-P. 21 in.
Exhaust ports, width	H.-P. 3 in., L.-P. 3½ in.
Bridge, width	1⅜ in.
Valves, kind of	Balance slide valves
Valves, greatest travel	H.-P. 5 in., L.-P. 6 in.
Valves, outside lap	1 in.
Valves, lead in full gear	1/16 in.
Boiler, type of	Wootten extended wagon top
Boiler, thickness of material in barrel	11/16 and ¾ in.

Seams, kind of horizontal	Sextuple riveted
Seams, kind of circumferential	Lapped and double riveted
Thickness of tube sheets	½ in.
Thickness of crown sheets	7/16 in.
Crown sheet stayed with radial stays	
Dome, diameter	32 in.
Firebox, material	Steel
Firebox, water space	Front 4 in., back 3½ in., and sides 3 in.
Grates, kind of	Cast iron, rocking pattern
Tubes, number	300
Tubes, material	Charcoal iron
Tubes, outside diameter	2 in.
Tubes, length over sheets	14 ft. 6 in.
Smokebox, diameter	73 in.
Smokebox, length	60 in.
Exhaust nozzle	Single
Exhaust nozzle	Permanent
Exhaust nozzle, diameter	4½, 4¾ and 5 in.
Exhaust nozzle, distance of tip above center of boiler	9 in.
Stack	Straight
Stack, inside diameter	16⅞ in.
Stack, height above smokebox	2 ft. 9 in.

Tender.

Type	Swivel truck
Thickness of sheets	5/16 and ¼ in.
Type of under frame	Steel channel
Type of truck	Fox pressed steel
Type of truck spring	Elliptic
Diameter of truck wheels	33 in.
Diameter and length of axle journals	5 by 9 in. (M. C. B.)
Tender weight, loaded	98,000 lbs.
Tender water capacity	4,500 gals.
Tender coal capacity	10 tons.

PORTABLE STEAM HEATING PLANTS.

Chicago & Northwestern Railway.

A convenient and profitable arrangement for caring for the steam heating plants for passenger yards at terminals and other large stations has been devised on the Chicago & Northwestern Railway. It is in the form of an old locomotive boiler mounted on an old 32-ft. 15-ton flat car with a suitable housing. It may be disconnected from the permanent piping and sent to the mechanical headquarters at the approach of warm weather for repairs and storage until again needed in the fall.

The boiler is supported on the car with the firebox projecting through a hole in the floor, the ash pan being below the line of the sills. One end of the car is partitioned off for coal supply, and temporary water pipes are laid and protected against freezing. The boiler is fed by injectors and the steam is led through the passenger yards by underground pipes for heating the cars. The location is chosen so that it will not be necessary to move the steam heating car during the entire winter. The illustration shows one of them as fitted up for the W. & St. P. division. A number of them are in use, and they appear to be generally satisfactory. The arrangement of windows and doors is clearly shown in the engraving, which was made from a photograph received from Mr. G. R. Henderson, Assistant Superintendent of Motive Power of the road.

Steam Heat Car for Passenger Yards—Chicago & Northwestern Railroad.

These cars have been arranged for the reception of the boilers by Mr. C. A. Schroyer, Superintendent of the Car Department.

HAND VS. PNEUMATIC RIVETING.

In our November number a comparison was made between hand and pneumatic hammer riveting on a locomotive firebox, showing the marked saving in cost by the latter method. We have further figures on the same subject comparing the cost of driving ⅞-in. rivets per day of 10 hours by hand and per day of 8 hours by the long-stroke riveting hammer. The figures are arranged for comparison as follows:

Hand Driven.		
2 Strikers at $3 each	$6.00	
1 Holder-on at $2.50	2.50	
1 Heater at $1.25	1.25	
Total	$9.75	
Average number of rivets driven, 375, at $9.75		$0.0260 each
Hammer Driven.		
1 Machine operator at $2.50	$2.50	
1 Holder-on at $2.50	2.50	
1 Heater at $1.50	1.50	
1/12th salary of engineer, 8 hrs. at 25c	.1666	
1/12th salary of fireman, 8 hrs. at 17½c	.1166	
1/12th cost of fuel at $2.50 per day	.2080	
Total	$6.9912	
Average number of rivets driven, 780, at $6.9912		0.0089 each
Saving per rivet driven		$0.0171 each
Saving		65 per cent.

These costs are taken from the records of several months' work, and they are believed to fairly represent what may be done anywhere under ordinary conditions. This work was done by the Boyer long-stroke riveting hammer, manufactured by the Chicago Pneumatic Tool Company.

The pension system has worked so well on the Pennsylvania Railroad that commencing January 1 it is to be extended to the Pennsylvania Lines West of Pittsburg. After that time all employees who reach the age of 70 years will be retired upon pensions amounting to 1 per cent. of the regular monthly pay for the ten years preceeding retirement for each year of service. If a man has had $100 per month for the last 10 years of his service, which covers 30 years in all, he retires on a life pension of $30 per month. When this plan goes into effect no person will be taken into the employ of the Pennsylvania System who is over 35 years of age unless by action of the Board of Directors. Such a pension plan may be expected to insure contentment and steadiness among the men and a relief from anxieties concerning labor struggles. It is humane, it is honest and altogether good business policy.

CORRESPONDENCE.

DECAPODS AND COMPOUNDS.

To the Editor:

I am much interested in the data supplied in the American Engineer for October, page 319, in specification and illustration of the new heavy four-cylinder compound locomotive of the "Soo Line," and which we would better recognize by its original class as "decapod" than as you have it, a "12-wheel"; at least, those most accustomed to them will so continue to class them.

The decapod is a class well adapted for the modern ideas of heavy weights, large boilers, wide fireboxes, large heating surfaces, high pressure, etc., where, in freight service, there is work to do at speeds within their necessarily low driver capacity, which, in an engine of this class and 55-in. drivers, will be under 25 miles per hour. To illustrate the facility of adaptation of the decapod to heavy and difficult situations of service, I will state that some years ago—1887—the decapod was supplied to the Northern Pacific road for use in mountain construction work and was used during two entire years on heavy grades and curves, on and through the Cascade range and tunnel construction, and became favorites with the engineering corps, who had entire control of them during that time. These decapods were lighter and of less capacity than the engine you illustrate, being plain, simple machines, 22 by 26-in. cylinders with 45-in. drivers, 2,310 sq. ft. heating surface, 140 lbs. steam pressure and 140,000 lbs. weight on drivers, with a driving wheel base of 17 ft. and the gauge of wheels compensated to render easily on the construction curves, which they did admirably.

Undoubtedly the compound feature of the "Soo Line" engine contributes largely to the success which your figures indicate, as they are given in the table of comparison with one of the heaviest class of simple engines, and propably compounding is responsible for its economy in tonnage cost per mile, and its splendid showing of relative capacity in effort made. This comparison and result brings plainly into contrast the relative merits of a simple and compound engine of nearly equal power; and, taken by itself, no doubt is correct in conclusion. There have, however, been recent instances of successes in each of these types which will perplex the average mind to decide between them. The "Northwestern" type simple engine with wide firebox, piston valves, high pressure and ample heating surface, show an economy in fuel of 20 per cent. over other engines, and this is their regular daily performance; while, on the other hand, the Chicago, Rock Island & Pacific new compounds, both freight and passenger, are capable of doing, and have done, 33 per cent. more work in tonnage hauled than other engines of the simple type, and with the same expense for fuel. In both of these instances the engines are worked up to their best effort.

To be correct in estimates of value of types, there should be given to each, all desirable features of design applicable to their type. Simple engines, for instance, referring to the C. & N. W. quoted above, should have wide boxes, large heating surfaces, piston valves, and whatever is found adding to their value—and the compound to have the same features so far as practicable.

It will be an interesting test when some road getting new power will decide to make it on strictly equal ground and terms—and when done, may we all be favored with a statement of result through the American Engineer.

Chicago, Ill. Geo. W. Cushing.

[Our correspondent directs our attention to a confusion of types of locomotives to which we must plead guilty, partially. The engine has twelve wheels. It is obvious that a proper classification of types is needed, and on page 374 of this issue will be found a suggestion on this subject.—Editors.]

A record of saving by the "Northwestern" type of 20 per cent. over other simple engines on the Chicago & Northwestern seems, in some quarters, to have led to the conclusion that there is no need for the compound locomotive if such improvements are being made in simple engines and we even hear of tests suggested between wide firebox simple engines and narrow firebox compounds, to learn which is better. An experienced physician once advised his students to make changes in treatment, one at a time, in order to be sure of knowing which medicine kills the patient. This seems rather suggestive in connection with the locomotive just now. A natural inference would be that if the compound is advantageous at all, it should be more so with other advantages, such as a wide firebox and a large boiler. That which improves the simple engine should be expected to also improve the compound, but perhaps not to exactly the same extent.

AJAX PLASTIC BRONZE.

The Ajax Metal Company, Philadelphia, are obtaining good results with their new bearing metal, which has been developed through their long experience and thorough study of the subject. This metal is an alloy of copper, tin and lead, combined through a patented process, whereby a relatively large proportion of lead is used without segregation. The difficulty has been to secure homogeneity with the desired proportion of lead, and this was some time ago accomplished successfully with this process, and the result is a metal which wears better than phosphor bronze because it has the all-important quality of plasticity.

Several years ago the Pennsylvania Railroad made exhaustive service tests with various combinations of copper, tin and lead, in order to determine the best composition which would be suitable for their service, and the conclusions drawn from the experiments were as follows:

1. The alloy of copper and tin shows 50 per cent. more wear than the standard phosphor bronze.
2. The phosphorus plays no part in preventing wear, excepting by producing sound castings.
3. Wear increases with the proportion of lead.
4. Wear diminishes with the diminution of tin.
5. Alloys containing more than 15 per cent. of lead, or less than 8 per cent. of tin, could not be produced because of segregation; but it was believed that if the lead could be still further increased and the tin decreased, and still have the resultant alloy homogeneous, a better metal in every respect would result.

The following table gives the results of these experiments:

Results of Pennsylvania Railroad Experiments.

	Composition.				
Metal Tested.	Copper.	Tin.	Lead.	Phosphorus.	Arsenic.
Phosphor Bronze, standard	79.70	10.00	9.60	.80	...
Ordinary bronze	87.50	12.50	....	...	...
Arsenic bronze, "A"	89.20	10.00	....	...	.80
Arsenic bronze, "B"	82.20	10.00	7.00	...	.80
Arsenic bronze, "C"	79.70	10.00	9.50	...	.80
Bronze, "X"	77.00	8.00	15.00	...	...
	77.00	10.50	12.50	...	...

Relative Wear.

Phosphor Bronze, standard	1.00	Arsenic bronze, "B"	1.15
Ordinary bronze	1.40	Arsenic bronze, "C"	1.01
Arsenic bronze, "A"	1.42	Bronze, "K"	.92
			.86

The predictions from the Pennsylvania experiments were confirmed by subsequent tests made by the Ajax Company on an Olsen friction machine in their own laboratory, and it was found that there is an almost constant relation between plasticity and wear. Their alloys showed less friction and ran at decidedly lower temperatures than those of the standard phosphor bronze. The results of these tests were as follows:

Tests on an Olsen Friction Machine.

	Friction (in lbs.).	Temperature (above temp. room).	Actual wear (in grains) 1,000,000 revolutions.	Compression at yield point (lbs. per sq. in.).
Phosphor Bronze	18½	50	10.5	31,700
Ajax Standard Engine	18½	32½	7.2	19,550
Ajax 21 per cent. lead	16	44	6.7	19,100
Ajax 30 per cent. lead	16	40	3.06	17,210
Ajax 47 per cent. lead	13½	34	1.65	6,690

This process is carried out in all the alloys made by these manufacturers, and by doing so segregation is prevented in cases requiring much smaller proportions of lead than is used in the plastic bronze referred to. It has been noticed by users of Ajax metal that present results are better than were formerly obtained, and the company expects to improve them still more.

PERSONALS.

Mr. E. J. Young has been appointed General Foreman of the Mechanical Department of the Illinois Central at Clinton, Ill.

Mr. F. P. Hickey has been appointed General Foreman of the Atchison, Topeka & Santa Fe, at Topeka, vice Mr. F. J. Gunther resigned.

Mr. F. P. McIntyre, Purchasing Agent of the Mexican Central, has removed his headquarters from Boston to No. 52 Broadway, New York City.

Mr. H. A. Parker, First Vice-President and General Manager of the Chicago, Rock Island & Pacific, has been elected to the presidency of that company, vice Mr. M. A. Low, resigned.

Mr. C. Skinner, Master Mechanic of the Toledo, St. Louis & Western, has been appointed Master Mechanic of the Chicago & Alton at Slater, Mo., succeeding Mr. W. J. Bennett, resigned.

Mr. Charles A. Bingaman, formerly connected with the engineering department of the Richmond Locomotive Works, has been appointed Mechanical Engineer of the Lima Locomotive and Machine Works, Lima, O.

Mr. Wm. Elmer has been appointed Assistant to Master Mechanic Stratton, of the Pennsylvania, at Altoona, Pa., vice Mr. J. T. Wallis, recently appointed Assistant to Mr. F. D. Casanave, Chief of Motive Power.

Mr. W. G. Moore has been appointed Assistant Treasurer of the Wisconsin Central Railway to succeed Mr. W. R. Hancock, promoted. Mr. Moore has, for a number of years, been secretary to the president and has had a long and successful experience in railroad service.

Mr. Charles C. Clark, for nearly eighteen years First Vice-President of the New York Central & Hudson River, has resigned that position on account of advancing years, and Mr. Edward V. W. Rossiter, heretofore treasurer, has been chosen Vice-President to succeed him.

Mr. F. C. Cleaver, Master Mechanic of the Louisville, Evansville & St. Louis Consolidated, has resigned to become Superintendent of Motive Power and Cars of the Wisconsin Central, with headquarters at Waukesha, Wis., in place of Mr. Angus Brown, resigned. Mr. Cleaver has been with the Louisville, Evansville & St. Louis since October, 1896, and was formerly for fourteen years Master Mechanic of the Terre Haute & Indianapolis.

John Hodge, Master Car Builder of the Atchison, Topeka & Santa Fe and one of the best known car builders in this country, died in Chicago, November 5, at the age of seventy-seven years. He was born at Ogdensburg, N. Y., in 1833, and had been in railway service since 1870. He was for sixteen years Master Car Builder of the Missouri Pacific, from 1886 to 1887 Superintendent of the St. Charles Car Works, and in 1887 became Master Car Builder of the Chicago, Santa Fe & California. Since August of the same year he has occupied a similar position with the Atchison, Topeka & Santa Fe. He will be greatly missed in the Master Car Builders' Association.

Mr. George B. Reeve, the former General Traffic Manager of the Grand Trunk, is to succeed Mr. Charles M. Hays as General Manager on January 1, 1901. Mr. Reeve entered railroad service in 1860 with the Grand Trunk, at the age of twenty years, as freight clerk at Montreal, working through various responsible positions. In 1873 he was appointed Assistant General Freight Agent and continued in that capacity until 1881, when he was made Traffic Manager of the company's western line, the Chicago & Grand Trunk. After serving on the Western lines for six years he returned to Montreal in 1896 as General Traffic Manager, which position he resigned last May after forty years of service in the Grand Trunk System.

Mr. Francis J. Cole, who is well known to our readers through his valuable articles in our columns, has resigned as Mechanical Engineer of the Rogers Locomotive Works to accept the position of Assistant Mechanical Engineer of the Schenectady Locomotive Works. He spent four years as an apprentice in the machine shops and was afterward draftsman on the Northern Central division of the Pennsylvania, and in 1881 because chief draftsman of the Trans-Ohio division of the Baltimore & Ohio, where he spent two years. In 1883 he went to the New York, West Shore & Buffalo, under Mr. R. H. Soule's administration. From 1885 to 1890 he was chief draftsman of the car and locomotive departments of the Baltimore & Ohio, and from 1890 to 1895 was Mechanical Engineer of the Baltimore & Ohio System. He was appointed Mechanical Engineer of the Rogers Locomotive Works in 1895, the position which he now leaves to go to Schenectady. Mr. Cole is a close observer and a careful student of the locomotive. He is an important acquisition to the engineering staff of the Schenectady Works and we congratulate both parties upon the appointment.

Henry Villard died at his home near Dobbs Ferry, N. Y., November 12. Mr. Villard came to this country in 1853 at the age of eighteen and started life as a newspaper reporter. His railroad career began in 1871, while on a visit to Europe. He formed a connection with Frankfort and Berlin bankers, and in 1873 returned to this country, buying for the German bondholders the property of the Oregon & California Railroad Company and the Oregon Steamship Company, of which he was made President in 1875. He became interested in other railway and navigation companies, which later became so involved that a collapse resulted, in which he lost very heavily. Returning to Germany, he formed new financial relations and came back to this country and started again as a capitalist. In 1890 he purchased from Thomas Edison his electrical manufacturing interests and with the Edison Lamp Company, Newark, N. J., and the Edison works at Schenectady, N. Y., organized the Edison General Electric Company, of which he was President for two years. In 1889 he became chairman of the Northern Pacific board of directors, but withdrew from railroad management after the panic in 1893, when he lost most of his fortune.

EFFECTS OF A COLLISION ON WESTINGHOUSE FRICTION DRAFT GEAR.

Butte, Anaconda & Pacific Railway.

We have received an account of a collision which occurred October 14 in the Anaconda yards of the Butte, Anaconda & Pacific Railway, which constitutes a demonstration of the value of the Westinghouse friction buffer. Incidentally it shows a surprisingly small amount of damage to the trains which were of pressed-steel cars, and on reading the account it is not to be wondered at that the end cars suffered somewhat. The result looks like a strong argument for good draft gear and steel cars, combined. The account is as follows:

Switch engine No. 3 was coupled to seven loaded pressed-steel ore cars at the east end of the yard, being on a side track. A man had been left to open the west switch, and, under the assumption that the track was clear, the engineer was given a signal to come ahead (west), pushing the cars. Twenty-nine similar cars (loaded) were at the other end of the siding,

about three-quarters of a mile from where the seven were coupled. As a result, a collision followed. No time for warning was given, and the seven cars and engine were moving at about thirteen miles per hour with the latter working steam. Under ordinary circumstances the air brakes would have been set on the twenty-nine care, and it is therefore assumed that such was a fact, though the number of cars showing evidence of having received a very severe shock gives rise to some doubt on this point.

The resultant injury to equipment consisted of the colliding ends of the two cars being considerably damaged, the worst being the seventh, or last, car from the engine. The damage to the other car was so much less as to enable it to be readily repaired by straightening the longitudinal sills and applying a new end sill. To facilitate this work (as repair material had to be ordered from Pittsburg), the end sill was removed from the car.

At the colliding ends, one coupler was broken in the shank, close to the head, and the other had the guard-arm broken off. The coupler was the "Standard," with solid knuckle. All of the cars were fitted with the Westinghouse friction draft gear, not one of which attachment, even on the colliding cars, was damaged in the least.

The opposite from the colliding ends of the two cars mentioned had slight kinks in the center sills, near the body bolster; the striking plate and end sill were bent in about 7/16 in., just back of the coupler head, and the coupler locking pin was wedged from the blow received through the knuckle of the opposite coupler. In 29 cars, 37 locking pins were so wedged. These were driven out, slightly ground, and returned to their couplers. About 20 cars had the center sills injured as described, but in no instance was the damage sufficient to require any repairs.

The average load of these ore cars is 110,000 lbs., their light weight is 34,800 lbs., and the engine, with tender, weighed about 150,000 lbs. For the engine and seven cars this makes a total of 1,163,600 lbs. At 13 miles per hour, and neglecting the effect of the steam being used, this represents a striking force of 6,575,000 foot-pounds, which is equivalent to the blow one of these 110,000-lb. capacity steel cars, fully loaded and weighing 72½ tons, would strike if dropped freely from a height of 54 ft. Even though no brakes were set on the 29 standing cars, their great weight and the small amount of slack between them insure that the enormous amount of energy in the engine and seven cars moving must have been dissipated in an exceedingly short distance.

That this was followed by such comparatively slight damage is a splendid tribute to the Westinghouse friction draft gear, to which Master Mechanic A. Harrity gives unbounded praise. While reducing greatly the consequent damage, it came out unscathed. Nor should the strength of the car or coupler pass unnoticed, though the weakest points in each, under buffing shocks, were demonstrated to be as described. The coupler has a 6-in. shank, in this being out of the ordinary.

TWO-CYLINDER COMPOUND CONSOLIDATION LOCOMOTIVE.

Minneapolis, St. Paul & Sault Ste. Marie Railway.

Heavy two-cylinder compound freight locomotives of the consolidation type have just been delivered to the "Soo" Line by the Schenectady Locomotive Works, and Mr. E. A. Williams, Mechanical Superintendent of the road, states that they have made their trial trips and are working very satisfactorily. We have received from him a photograph and some of the leading dimensions.

Two-Cylinder Compound Consolidation Locomotive, "Soo" Line.
E. A. WILLIAMS, MECHANICAL SUPERINTENDENT. SCHENECTADY LOCOMOTIVE WORKS, BUILDERS.

These engines are designed to haul 1,692 tons of train, exclusive of the weight of the engine and tender, up a 42-ft. grade 10 miles long, and to do this when working as compounds. The cylinders are 22½ and 35 by 30 in., the drivers are 55 in. and the boiler pressure is 210 lbs. The tractive power is 38,660 and the heating surface 2,549 sq. ft. A piston valve is used on the high pressure side, while the other has an Allen-Richardson balanced valve. Among the other details we note extended piston rods and brake shoes at the rear of the driving wheels. The design is attractive for such a large engine. The following partial list of the dimensions presents a good idea of the design:

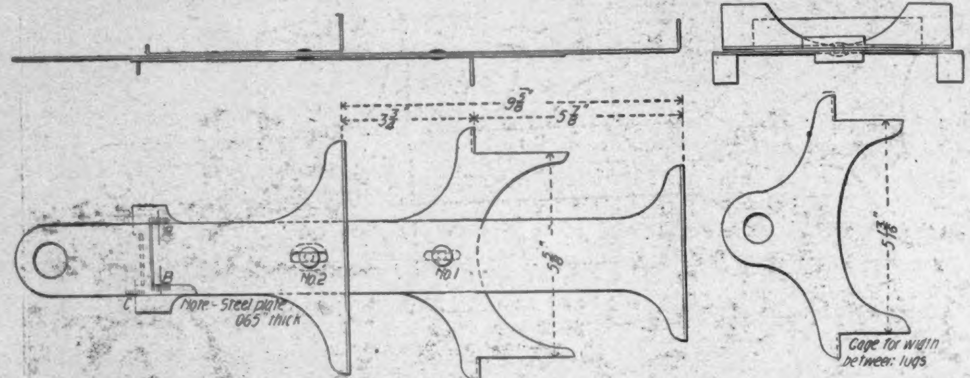
Builders	Schenectady Locomotive Works
Type	Compound Consolidation
Cylinders	22½ ins. and 35 ins. diameter by 30 ins. stroke
Traction power	38,660 lbs.
Valves	H.-P. piston valve, L.-P. Allen-Richardson balanced
Driving wheels	55 ins. over tires
Weight on drivers	154,500 lbs.
Weight on truck	21,600 lbs.
Total weight, engine	176,100 lbs.
Weight of tender loaded	115,600 lbs.
Total weight of engine and tender	291,700 lbs.
Rigid wheel base	16 ft. 0 in.
Wheel base of engine	24 ft. 1 in.
Wheel base of engine and tender	53 ft. 9 in.
Boiler	Straight top, radial stays
Working steam pressure	210 lbs.
Diameter of boiler at arch	73½ in.
Firebox	length, 120 ins.; width, 41 ins.
Tubes, number	320
Tubes, diameter	2 ins.
Tubes, length	14 ft. 0 ins.
Heating surface, firebox	193 sq. ft.
Heating surface, tubes	2,356 sq. ft.
Heating surface, total	2,549 sq. ft.
Grate area	34.16 sq. ft.
Height from top of rail to top of stack	14 ft. 10 ins.
Height from top of rail to center of boiler	8 ft. 6 ins.
Capacity of tender, water	6,000 gals.
Capacity of tender, coal	10 tons

On the Maine Central a peculiar failure of air brakes was recently noted. An obstruction was discovered in the train pipe hose, and upon investigation a dead mouse was found. The animal had crawled in through the coupling.

GAUGE FOR 5 BY 9 JOURNAL BOX.

Delaware, Lackawanna & Western Railroad.

Mr. J. D. Murray, of the Delaware, Lackawanna & Western, has sent us a drawing of a convenient gage devised by him and adopted by Mr. L. T. Canfield, Master Car Builder of that road, for use in connection with 5 by 9-in. M. C. B. journal boxes. It has three parts, the middle member runs to the back of the box and is turned up at the end, the top member is turned up to catch the front lugs in the top of the box, and the bottom member engages the lugs at the center of the box and allows for the width of the standard M. C. B. bearings and wedges. The scale, A, measures the distance between the front and center lugs, or the distance 3¾ ins. as indicated on the drawing. The scale B measures the distance from the front to the back of the box, or that indicated as 9⅝ ins. The scale C measures the distance between the center lugs and the back of the box, indicated as 5⅞ ins. The right-hand rivet holds the bottom to the middle part and the other rivet holds the top to the middle one.



Convenient Gauge for 5 by 9 M. C. B. Journal Box—Delaware, Lackawanna & Western R.R.

The gage may be used to measure old boxes in service when the bearing and wedge are removed, and it is also useful in measuring boxes in the inspection of cars at the works of the builders. For the latter purpose it is found to be more convenient to reverse the arrangement of the scales and measure the boxes when turned upside down. For a gage to measure the width between the lugs Mr. Murray uses a separate piece of the same shape as the bottom member of the combination gage, but shorter. It is illustrated in the sketch. These gages were devised from a suggestion received from Mr. Whyte's article on page 273 of our September number, in which the 5 by 9 journal box was criticised.

The comments upon brass furnaces in general and upon the furnace designed by Robert Wagner, of Germany, in our November number, were made with the idea that the customary brass foundry methods are very crude and that improvements, particularly in the melting furnaces, would result in considerable saving. The comments were made in ignorance of the fact that the particular furnace referred to is controlled and manufactured in the United States by the Ajax Metal Company of Philadelphia. This furnace has been used by this company for seven years with excellent results. In fact it is believed that there is no better furnace known at present for the smelting of brass. It has stood the test of experience and the fact that the Ajax people use it in their commercial practice and that they thought so well of it as to secure the exclusive ownership of the rights in this country, is enough to say of it as a practical success. We illustrated the furnace because it attracted our attention as an important improvement and it is pleasant to learn that our opinion of it has such substantial and unqualified indorsement.

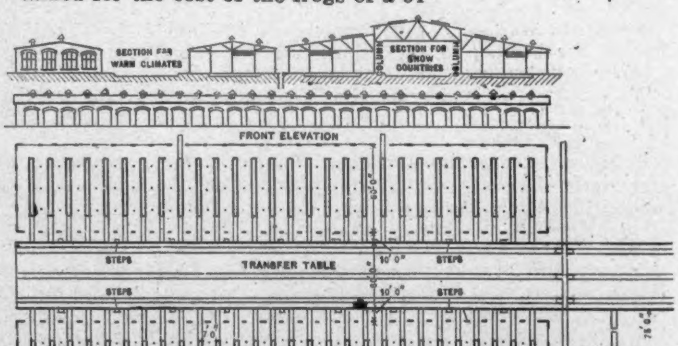
ROUND VS. RECTANGULAR "ROUNDHOUSES."

The locomotive "roundhouse" has by universal consent become the building used for the temporary housing of locomotives in this country until the mere suggestion of any other form of building for this purpose will occasion surprise. Mr. John D. Isaacs, Assistant Engineer, Maintenance of Way of the Southern Pacific Company, at San Francisco, recently offered a scheme for a rectangular arrangement of engine house for discussion before the Pacific Coast Railway Club, which is worth looking over. We reproduce two diagrams illustrating his suggestion.

The advantages urged for the rectangular building are: (1) It provides for the possibility for extension; (2) renders it easy to use cranes over the engines; (3) saves loss of storage room for stalls which must be kept free for access to a roundhouse; (4) saves one turning of engines which must always be turned twice on a roundhouse turn-table.

Track Arrangement.

The rectangular engine house requires a turn-table and also a transfer table, but Mr. Isaacs says that the transfer table can be built and maintained for the cost of the frogs of a 54-stall roundhouse. He believes the time required for handling engines would be about equal in both plans, and as to the land occupied by the two classes of buildings, he makes the following comparison:



Scheme for Rectangular "Roundhouses."

A circular engine house with, say, 57 stalls would occupy a neat area of 3.02 acres. Assuming that three of these stalls would be kept unoccupied for access to so large a building, the actual capacity would be 54 engines. A rectangular engine house with 54 stalls would occupy a neat area of 2.6 acres, or about 16 per cent. less area than the circular building. But the roundhouse may be considered as occupying a square of ground the sides of which are the diameters of the circle. To offset this there should be added, say, 110 ft. to the length

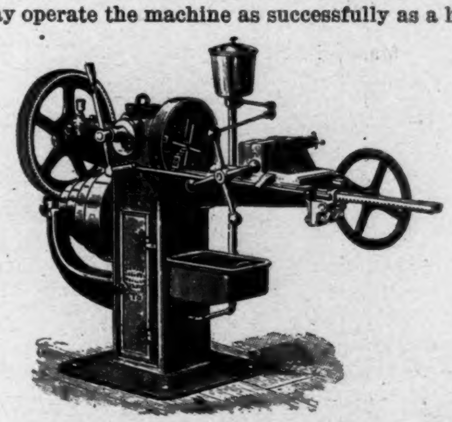
of the rectangular house for the extra length required for the transfer pit outside of the building, and the areas then become: Rectangular building, 2.74 acres; circular building, 3.86 acres; or about 40 per cent. more for the roundhouse.

The actual space occupied by the engine house, however, is seldom as important as the shape of the ground space, and the facilities for getting a good track arrangement and good location for the coal chute, water crane, sand house and ash pit. Mr. Isaac's suggestion is presented here for two reasons. It is a plan which may work out better than the roundhouse in certain difficult cases and it may prove to stimulate thought upon the question of terminal facilities for handling locomotives which is becoming more important with every increase in congestion of traffic.

THE SCHLENKER BOLT CUTTER.

Howard Iron Works, Buffalo, N. Y.

This machine uses dies similar in action to a lathe tool, leaving a clean and perfect thread with one passage over the bolt, and when the required length of thread has been cut the dies open automatically. The dies are simple in form, which reduces their first cost below that of many forms, and when dull they may be ground like a lathe tool and re-cut many times before they are worn out. Their attachment or detachment may be effected instantly, without removing a screw, pin or bolt. The machine will cut either right or left handed, square, V-shaped or coach threads, and a specially strong claim is made for accuracy. The design was guided by a desire to render the operation so simple that any intelligent boy who can read figures may operate the machine as successfully as a high-priced



The Schlenker Bolt Cutter.

mechanic. The gears and pinions are cut, the wearing parts are of steel and carefully fitted, the bearings are large and are provided with adjustments to take up wear. The machines will tap nuts as well as thread bolts and will take crooked work as well as straight. They are made in a number of sizes and capacities from ¼ in. to 3 ins. in diameter. Our engraving illustrates their general features and gives the impression of convenience, strength and compact form. The manufacturers are the Howard Iron Works, Buffalo, N. Y., who also manufacture pulleys, hangers, shafting, vises, pulleys, clutches and special machinery.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

The forty-second meeting of this society will be held in the rooms at 12 West 31st Street, New York, December 4 to 7, with the following programme of professional papers:

Parsons, H. de B.: "Comparison of Rules for Calculating the Strength of Steam Boilers."

Porter, Chas. T.: "A Record of the Early Period of High Speed Engineering."

Thurston, Robt. H.: "Steam Engine of Maximum Simplicity and of Highest Thermal Efficiency."

Sangster, Wm.: "Note on Centrifugal Fans for Cupolas and Forges."

Dean, F. W.: "Power Plant of the Massachusetts General Hospital."

Bolton, Reginald P.: "The Construction of Contracts."

Adams, E. T.: "An American Central Valve Engine."

Wickhorst, Max H.: "Mechanical Integrator Used in Connection with a Spring Dynamometer."

Read, Carleton A.: "Apparatus for Dynamically Testing Steam Engine Indicators."

Goss, W. F. M.: "Tests of the Boilers of the Purdue Locomotive."

Bristol, W. H.: "A New Recording Air Pyrometer."

Wheeler, F. Merriam: "Comparative Value of Different Arrangements of Suction Air Chambers on Pumps."

Gregory, W. B.: "Tests of Centrifugal Pumps."

Keep, Wm. J.: "Hardness, or the Workability of Metals."

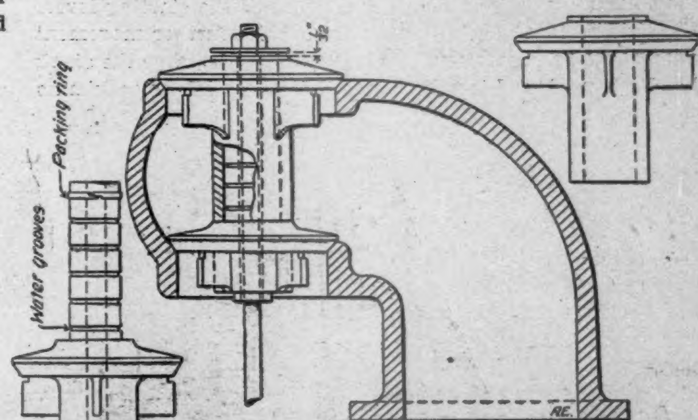
Sargent, Chas. E.: "New Principle of Gas Engine Design."

Kerr, C. V.: "Heat Efficiency of the Gas Engine as Modified by Point of Ignition."

Jones, Forrest R.: "Power and Light for the Machine Shop and Foundry."

CHAMBERS' COMPENSATING THROTTLE VALVES.

A new throttle valve by Mr. John S. Chambers, Master Mechanic of the Central Railroad of New Jersey, at Elizabethport, N. J., has been adopted as standard on that road by Mr. McIntosh. It is designed to provide for automatic adjustment of the disks of the throttle to provide for differences in the expansion of the throttle casing and the valve itself. With the usual construction, and the valve made in one piece, considerable difficulty is found in keeping the valves tight. To overcome this Mr. Chambers makes his valve in two parts, shown in the detail views. The upper disk has a sleeve which surrounds a corresponding sleeve on the lower disk. The spindle



Chambers Improved Throttle.

passes through both and under the washer at the top; a space of 1/32 in. is provided for automatic adjustment of the distance between the disks. The inner sleeve has water grooves and it may also have a packing ring at the top to guard against leakage of steam between the sleeves.

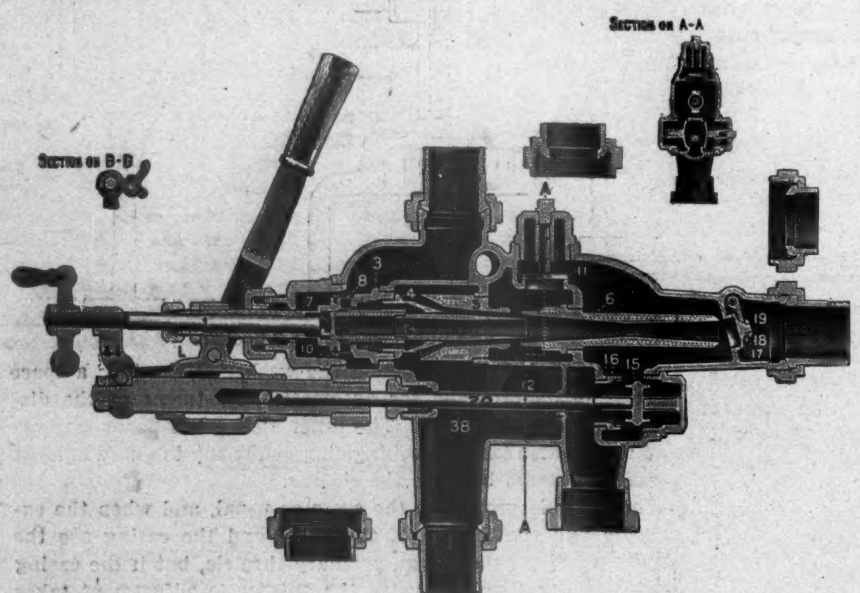
The valve is ground to the seats as usual, and when the expansion and contraction of the valve and the casing are the same the valve acts like an ordinary throttle, but if the casing expands more than the valve the automatic adjustment takes care of the difference, which must at all times be very small, and experience shows that the valve remains tight. Mr. Chambers expects these valves to remain tight between the periods of general repairs to the engines. As it costs about $8 to grind a leaking throttle, a considerable saving is expected.

Careful examination of the drawing may lead to the question of the tightness of the lower disk against its seat when the casing expands more than the valve, because the steam pressure upon the lower disk must tend to raise it until stopped by the lower end of the sleeve of the upper disk. As stated, there seems to be no leakage, and this probably means that the amount of difference in expansion is very small, probably not more than the thickness of a film of water between the two disks. When the throttle is operated the two disks seem to move together as in the usual construction. The improvement has been patented by Mr. Chambers.

THE LUNKENHEIMER "99 MODEL" INJECTOR.

The "99 Model" Lunkenheimer standard locomotive injector has been redesigned with a view of meeting the severe requirements of a service involving a wide range of loads and temperatures. It can be started promptly, under most conditions, at all pressures from 30 to 250 lbs., and is not sensitive, there being no fear of uncertainty of action. It works without adjustment of the steam or water at pressures between 40 and 250 lbs., and the capacity may be reduced over 50 per cent. at all points. In this model, when the water discharge is reduced the steam consumption is also reduced in direct proportion, instead of the water supply being alone cut down. This is the basis for a claim for economy superior to that of other makes. Durability was prominently in mind in its development. The overflow valve is held positively to its seat when working and all of the water is forced into the boiler. The lifting and forcing tubes are combined in one line, the only tube subject to appreciable wear being the forcing combining tube, which is made large and is free from spill holes. It may be easily renewed and at slight expense when necessary. All of the tubes are screwed in from the same direction and all may be removed or replaced without dismantling or disconnecting the injector more than to remove the steam valve bonnet. The valves are also conveniently placed and accessible and the body casting is in a single piece. The line check valve is of the swing pattern which gives a full waterway and when worn in the seat it may be reground without removal from the body of the injector.

The starting is by a single movement of the starting lever; the first portion effects the lifting and the further movement puts it into full operation. To regulate the discharge the crank handle is used, and it will change the capacity from maximum



Lunkenheimer Injector.

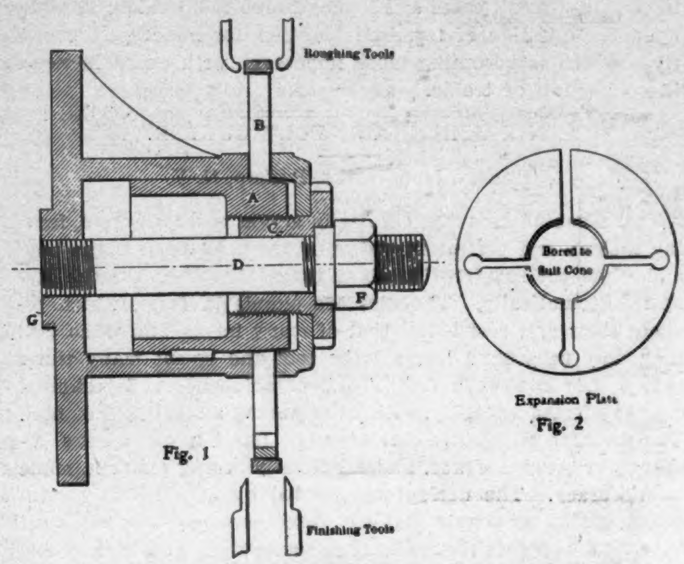
to minimum at all pressures between 40 and 250 lbs. It is necessary to manipulate the crank handle only at pressures below 70 lbs.; above that pressure the injector is started without reference to the delivery and the water is regulated afterward without danger of breaking the stream. On short lifts the water may be as hot as 135 deg. F. at all pressures up to 250 lbs. A convenient and simple heater attachment is provided. All injectors are tested before shipment to pressures up to the limit stated and with water at 76 deg. F., with a lift of 5 ft. They are also tested for working hot water.

The manufacturers, the Lunkenheimer Company, Cincinnati, O., have had remarkably successful results with this model. This is the only injector on the market which cuts down the steam consumption in direct proportion to the amount of water discharged.

MANDREL FOR FACING PISTON RINGS.

The accompanying engraving illustrates an expansion mandrel for use in facing piston rings on both sides at one operation and was described by Mr. G. R. Martin, of Thames Ditton, in a recent issue of the "American Machinist." We have seen many schemes devised for doing this work, but none quite so effective and convenient as this.

The features of this device are the expansion disk marked



Mandrel for Facing Piston Rings.

B in Fig. 1, around which is placed the ring to be faced, and the mechanism used to effect this expansion. A front view of the disk is shown in Fig. 2. The main body casting, which is presented in section in the drawing, is screwed to the face plate of the lathe, the projecting part, G, fitting into the hole in the face plate and serving as a guide in setting the mandrel. Cylinder A slides freely inside of the main casting, but is feathered to prevent it from turning. One end of this cylinder is cone-shaped, the taper corresponding with that of the expansion plate. A sleeve, C, fits loosely over the stud bolt, D, and screws into the cone and is held in position by the nut, F.

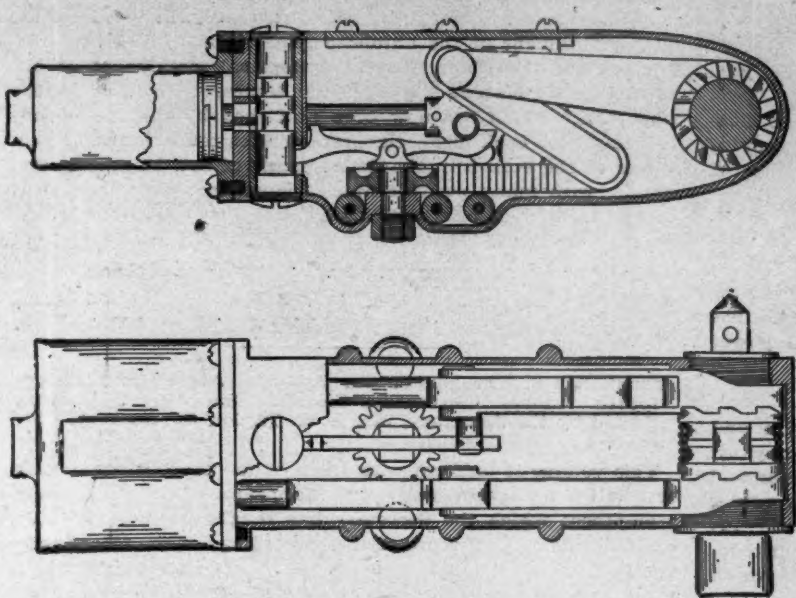
To go through the operation, the ring is placed around the expansion disk, the sleeve, C, screwed sufficiently tight with the fingers to hold the ring, while it is set true by running the lathe and holding the blunt end of the tool to the face of the work. The sleeve and nut, F, are then further tightened to hold the ring firmly.

The frankness with which American machinery builders and manufacturers usually show their products and open their works to visitors calls out frequent comment from foreign engineers which serves to bring out the contrast between different nationalities in this respect. We are not losers by showing others what we have, for in the very act of showing we may acquire a suggestion of improvement and a thing guarded and maintained secretly cannot grow as it would in the open air. Furthermore, one who is large-minded enough to show his ways to others is likely to be shrewd enough to learn from others.

U. & W. PISTON DRILL.

The drill shown in the accompanying engraving is that of the U. & W. Piston Air Drill, manufactured by the Columbus Pneumatic Tool Company of Columbus, Ohio. It is of an entirely different design from other machines of this class, and embodies some novel and practical ideas.

This machine is of the double-piston type, both pistons working through the medium of arms and cross-heads upon a single shaft, turning it with the power derived from both cylinders. In order to effect this concentration of power a gear is placed between the cross-heads, working in racks cut at the base of each. The successive strokes of the cross-heads move the ends of the arms up and down. The other ends of these arms encircle the shaft and have teeth interlocking those in clutches, which, in turn, move along the shaft and engage lugs on it, thus revolving the shaft. The teeth of the arms and clutches never engage except on the forward stroke, or at the time of the upward movement of the end of the arm. As air enters the cylinders at the end of each stroke, it will be seen that the gear referred to above is of great importance, inasmuch as it is the medium of transmission of the power developed in the return stroke to the side on the forward or working stroke.



U. & W. Piston Air Drill.

Two valves and a shifter distribute the air. The auxiliary valve is set by the shifter in its movement up and down, and the main valve is set by air properly admitted by the auxiliary.

The points of superiority claimed for this tool are durability, capacity for doing work in close quarters, strength, lightness, and the absence of the necessity of frequent oiling.

It was once said by a Scotch university professor to a rather stupid student, "Mon (he spoke in his native Scotch), I can teach ye Latin and I can teach ye Greek, but common sense is beyond my power tae gi' ye; if ye ha'e na that ye air to be pitied."

In describing the interesting water scoop for tenders on the Lake Shore & Michigan Southern, on page 345 of our November issue, we stated that the castings were of malleable iron. This is misleading, as a glance at the drawings will at once show. The drawings were made for cast iron parts, and we should have stated this fact, and also that malleable iron was considered for future practice. This opportunity is taken to point again to the feature of this design whereby machine work on the jointed sections is avoided.

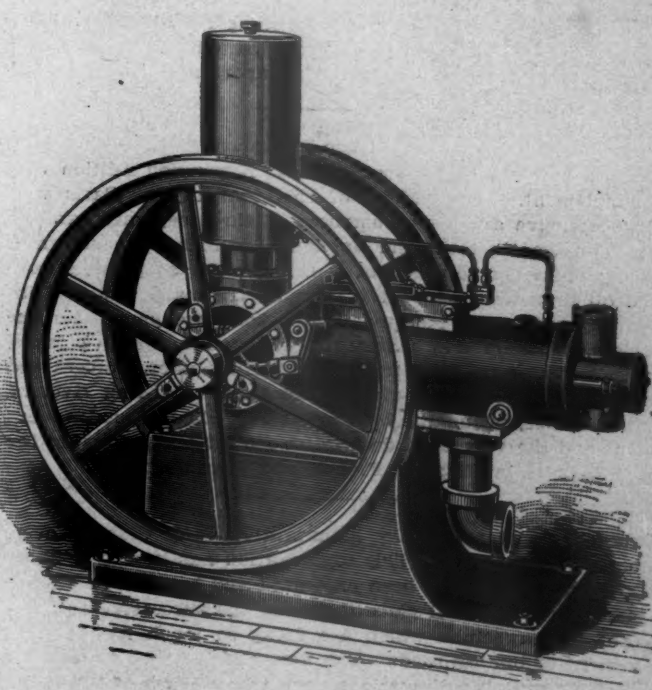
MIETZ & WEISS KEROSENE ENGINE.

The fact that kerosene is available everywhere at a low cost and has the necessary qualities of a good fuel with the highest thermodynamic value, has opened a large field of usefulness for the kerosene engine in isolated electric lighting plants and railroad pumping stations.

Its ease of management, economy, and safety recommend it as a very desirable motor in places where the steam engine is inconvenient for many reasons. It is true that in the modern steam engine as a power transmitting machine the chances for real improvement are very limited, but summing up all its necessaries as a prime mover, starting at the coal mine, or even at the coal yard, we have an entirely different situation. The four-cycle single cylinder gas engine, receiving, as it does at its best, only one power impulse for every two revolutions of its shaft, is not the ideal electric light engine.

The engine shown is of the two-cycle compression type, receiving a power impulse every revolution and provided with a sensitive governor maintaining the steady speed required for belted or direct coupled generators. A small pump operated and controlled by the governor injects the precise amount of kerosene (ordinary lamp oil) directly in the motor cylinder, where it vaporizes and mixes with air for combustion.

The oil reservoir is placed at the side of the engine frame and at a certain point in each revolution a partial vacuum is created in the crank chamber and in the cylinder. This is sufficient to draw the necessary oil from the pipes and down past the sight holes which permit its proper regulation by the valves above. The oil for the crank drops into a groove on the top of the rod, whence it finds its way to the pin. The automatic oiling devices, it will be noted, are only operative when the engine is running, and when the engine is stopped they require no attention. When the engine is to be stopped it is only necessary to throw up the little finger which regulates the oil supply.



Mietz & Weiss Kerosene Engine.

Catalogues and blue prints of this engine can be had by applying to August Mietz, 128-138 Mott street, New York.

BOOKS AND PAMPHLETS.

Machine Tools.—The Hilles & Jones Company, Wilmington, Del., have just issued a tasteful catalogue of machine tools for working plates, bars and structural shapes. Among the tools of large capacity illustrated are single and double punches and shears, coping and notching machines for I-bars, channels and angles, railroad fish-plate punches and fish-plate notchers; also bending and straightening machines. The engravings are excellent half-tones and the work throughout is of high character.

Westinghouse Railway Motors.—A pamphlet of 44 pages illustrating and describing the Westinghouse standard types of railway motors has just been received. It presents a number of different designs which have been evolved in the 10 years' experience of the Westinghouse concern, to meet various conditions of service and equipment. Special attention has been given to the construction of the motors to avoid a difference of temperature rise in the field and armature windings and the ventilated armature is carried to a high development. The pamphlet also contains illustrations of a few typical power stations.

Bolt Threading Machinery.—Based upon the extensive and varied experience which the Webster & Perks Tool Company, of Springfield, Ohio, have had with all kinds of screws and bolts and many different makes of machines for manufacturing bolts, they are offering a line of solid die, automatic threading machines which are very effective and simple in construction. Their new catalogue on bolt threading machinery which has just been received illustrates and briefly describes their two spindle, rapid, direct, belted and one, two, four and six geared solid die automatic threading machines. This concern also manufactures grinding and polishing machinery, which is described and illustrated in a special pamphlet. This class of machinery is growing constantly in importance.

Pneumatic Tools.—The Chicago Pneumatic Tool Company has issued a new catalogue which is their Exposition Edition with a supplement. The exhibits of this company at Paris were very extensive and were composed of three separate exhibits. Their pneumatic tools and appliances, which were shown in direct application to practical work, in so far as possible, covered all branches of industry. Among the many new and interesting appliances pictured in this book are pneumatic flue welders, reducers and expanders, car and locomotive jacks, cranes mounted on hand trucks for loading axles, timbers and car trucks, improved oil-rivet heaters and mud-ring riveters, and, of course, pneumatic hammers. The illustrations are excellent and the very brief descriptive matter accompanying the engravings is in English, French and German.

Proceedings of the Rocky Mountain Railway Club, Denver, Colorado, October, 1900.—This organization has in a very short time, about six months, been organized and brought to a state of efficiency which will place it among the successful and important railway clubs which are doing so much for the improvement of our railroads. The first copy of the proceedings to reach us contains discussions upon the subjects of "Brown's Discipline" and the delays to trains. Both are important and they indicate a broad view of the possibilities of such an organization on the part of the officers. We are in hearty sympathy with efforts to improve railroad practice through clubs of this kind.

Steel Rails and Fastenings, Vol. II., 1900.—The Cambria Steel Company, Philadelphia, have just issued a book entitled "Steel T-Rails and Fastenings." This volume, which is number two, shows sections of T-rails and their joints, T-rail guards and frog fillers; also gives in the form of tables, useful information regarding the materials used for track construction, such as the number of tons of rails required per mile, of various weights per yard, number of spikes, cross ties, splice bars and bolts per mile of track, and the number of joint fastenings to the ton of rails. The book also contains an extensive list of the different railways and the weight and section number of the rails used by each. The list shows that most of the roads have adopted as standard the "American Society of Civil Engineers" sections, to which about 75 per cent. of all rails made last year by American mills were rolled.

The contents of the December Magazine Number of The Outlook are varied. Among the special articles will be found the fifth installment of the autobiography of Booker T. Washington, called, "Up From Slavery;" the final installment of Mr. Hamilton W. Mabie's "William Shakespeare: Poet, Dramatist and Man," which has now been published by the Macmillans in sumptuous book form; elaborate articles reviewing the ablest books of the season in the departments of art, biography and fiction, with many portrait illustrations; and, most prominent of all, a series of brief articles by such men as James Bryce, Henry van Dyke, Edward Everett Hale, President Hadley, of Yale, and half a dozen others, giving their opinions in reply to the question "What Are the Greatest Books of the Century?" The Outlook Company, 287 Fourth Avenue, New York.

Proceedings of The Master Car Builders' Association, Thirty-fourth Annual Convention, Held at Saratoga, June, 1900. Edited by the Secretary, Mr. J. W. Taylor, 667 Rookery, Chicago, Ill.

This volume is uniform with those of the proceedings of this association for several years, and it appears with the customary promptness which the Secretary has taught us to expect. It contains the official record of the proceedings of the recent convention, the constitution and lists of officers and members and a complete set of the drawings of the standards and recommended practice of the association. These are put in most convenient form for reference. Our readers are familiar with the work of this association and know the value of the records. The subjects for next year, which we printed last month, promise an unusually interesting convention next summer, with specially inportant discussions.

Air Brake Catechism. A Complete Study of the Air Brake Equipment, Including the Latest Devices and Inventions Used. All Troubles and Peculiarities of the Air Brake and Practical Ways to Remedy Them. By Robert H. Blackall, Air Brake Instructor and Inspector, Westinghouse Air Brake Company. Illustrated. Published by Norman W. Henley & Co., 132 Nassau street, New York. Price, $1.50.

This is the most satisfactory book upon the air brake. It is written by a practical expert who is familiar not only with the subject, but with methods of explaining it, and it is both convenient in form and moderate in price. It is not strange that it has gone through twelve editions. We have printed notices of previous editions and can add at this time that the work is kept strictly up to date. It is well adapted to the use of students and to men who use and maintain the air brake because of its clear and concise treatment of the entire subject. The engravings are clear enough, but with the exception of the folding plates they do not call for especially favorable comment. To one who desires to know how the air brake operates and how to maintain it or use it this book will be invaluable.

Freehand Perspective: For use in Manual Training Schools and Colleges. By Victor T. Wilson, Instructor at Cornell University. Published by John Wiley & Sons, New York, 1900. First Edition, 268 pages; illustrated. Price, $2.50.

Those who have had instructional work in the crafts, whether as teacher in a technical school or as director of workmen in a shop, have felt the need of the ability to use the methods presented by Mr. V. T. Wilson in his treatise on Freehand Perspective. While one might wish that the subject could be presented in a more concise form, in looking through the book he has difficulty in selecting a place where he would wish to prune. The arrangement is consecutive, and the illustrations are sufficiently numerous, even for this subject, and are well chosen. Familiarity with the methods developed by the author would be undoubtedly of great value to the mechanical draughtsman, as the necessity for the perspective sketch,

either to elucidate a mechanical drawing or as a memorandum, is of constant recurrence. The treatment of the mathematical side of the subject develops all that is necessary of it in a simple manner, and the illustrative sketches are happily selected and well executed.

Exhausters, Heaters and Engines.—The New York Blower Company, 39-41 Cortlandt street, New York, has just issued a very neat catalogue, illustrating and briefly describing their exhausters, sectional heaters and engines. This, their first catalogue, does not give a complete line of the products manufactured by them, but is issued as a sort of introduction to the trade. Besides steel plate exhausters for exhausting air, smoke, gases or material of a granular, pulpy or fibrous character, they are building a complete line of heaters, blowers and engines, together with ventilating, drying and mechanical draft apparatus and appliances. These are built upon the most approved and advanced lines. The exhausters, with the exception of cast-iron bed plates, inlet and outlet rings and the heavy pedestals which support the running parts, are made throughout of steel plate, re-enforced by substantial wrought angle iron frames. This construction enables these machines to sustain without injury the sudden strains caused by knots, blocks, etc., passing through, which would quickly wreck the ordinary cast iron exhauster. A noteworthy feature of the catalogue is its clear line engravings with lettered dimensions and accompanying tables giving in inches the values of the indicated letters for a large number of sizes of exhausters. The catalogue should be in the hands of all users of this class of machines.

"Atlantic Type Locomotives" is the title of pamphlet No. 20 in the series entitled "Record of Recent Construction," issued by the Baldwin Locomotive Works. This pamphlet surpasses in attractiveness all previous ones in this interesting series. This number is devoted to the "Atlantic Type" and it contains descriptions and records of a large number of engines by these builders, several of which have become world famous, for example, those hauling the Atlantic City Flyer of the Philadelphia & Reading. The reason for the introduction of this type is stated in a quotation from the article by Mr. Edward Grafstrom, now Mechanical Engineer of the Atchison, Topeka & Santa Fe, in the American Engineer and Railroad Journal of May, 1900, which may be summed up as follows: This type permits of securing large steam making capacity without involving the use of six coupled wheels. The pamphlet contains excellent half-tone engravings of the locomotives, accompanied by perspective diagrams giving the leading dimensions and wheel base. Most valuable letters from motive power and operating officers are included and they present the facts of experience in mileage and performance. These are in both French and English. The publication is wholly admirable and worthy.

Baldwin Locomotive Works.—Illustrated Catalogue of Narrow-Gauge Locomotives. Especially Adapted to Gauges of 3 ft. 6 in. or 1 Meter. This is a revised edition of the earlier catalogue of narrow-gauge locomotives by these builders. The book, which has 452 pages, opens with an elaborate history of the Baldwin Locomotive Works, in which their development to the present enormous establishment is traced. This is followed by general specifications of locomotives, physical tests of material and class designations. A number of tables of dimensions of locomotives, accompanied by full-page half-tone engravings, introduce the subject of the Vauclain system of compounding, which is described in detail with engravings of the essential parts. The latter half of the work contains instructions for cabling; also a series of diagrams of various types of locomotives. An elaborate series of illustrated plates with the parts numbered is included for the aid of those who desire to order parts for repairs. The book will be very useful to those who desire to investigate the Vauclain system to order locomotives of these types, and especially to those who already have them in service and who have occasion to order repair parts. It is bound in cloth and is provided with an excellent index.

Messrs. Manning, Maxwell & Moore, New York, have just issued a 700-page illustrated imperial quarto catalogue of Machine Tools and Their Attachments. It illustrates only metal and wood working machinery and their accessories. Owing to the greatly increased scope of their business this firm finds it advisable to separate these tools from what are termed "general supplies," which were all combined in previous catalogues. This leads to the compilation, now under way, of complete illustrated catalogues of railway, steamship, machinists' and contractors' tools and supplies, which will contain over 800 pages of the size of the present volume. The catalogues of this firm cover so wide a field that one of them is a compendium of the present state of the art in its line. In this volume, as in previous ones, each illustration has a figure number for the purpose of ordering from the catalogue. The figure numbers are intended to be used in preference to the names of the tools. The catalogue is also provided with a code by which telegraphic and cable communications may be greatly condensed. For customers who find it more convenient to communicate with branch offices, attention is called to the fact that they have a large store in Chicago, in charge of Mr. A. J. Babcock as manager, at 22, 24 and 26 South Canal Street, where there is carried a full and complete stock of the latest improved machine tools, ready for quick delivery; a large office in Pittsburg, at 1005 Park building, in charge of Mr. Robert A. Bole, and in Cleveland an office at 1620 Williamson building, in charge of Mr. F. B. Ward. In New York there are three large warehouses, outside of the commodious store, filled with machinery for prompt delivery. It is impossible to present an idea of the catalogue under review better than to say that the wants of those requiring machinery of this general character will be found to be anticipated in its pages. It is a valuable book and represents a very large amount of labor. It has every appearance of having been carefuly compiled. Each machine is concisely described and the chief dimensions and figures of capacity are included.

EQUIPMENT AND MANUFACTURING NOTES.

The Richmond Locomotive Works have received orders for six locomotive boilers from the Central Vermont Railway, and for one locomotive boiler from the Cincinnati Northern Railway.

The Boston Belting Company, 256 Devonshire Street, Boston, are distributing advertising blotters which are acceptable everywhere because they are really good ones and will absorb ink on either side. A set of them will be sent upon application.

The Missouri Pacific Railway Company has placed an order with the American Car & Foundry Company for 500 low-floor furniture cars, which are to be equipped with the Shickle, Harrison & Howard Iron Company's cast steel trucks and bolsters.

The Boston & Maine Railroad and its connections lead direct to the great game regions of Maine and New Hampshire, and the publication which is issued by the Boston & Maine Passenger Department, Boston, known as "Fishing and Hunting," describes how and where to shoot. Send for it; the cost is but a two-cent stamp.

It is stated that the preferred stockholders of the Pratt & Whitney Company, which has been absorbed by the Niles-Bement-Pond Company, will receive 70 per cent. in new preferred stock and 30 per cent. in common. The Niles-Bement-Pond Company has declared a regular dividend of 1½ per cent. on its preferred stock.

The business of the New York Blower Company, heating and ventilating engineers, has developed to such a point as to necessitate opening a branch office in Chicago, which they have done in the Merchants' Loan & Trust Building. This company now has offices in New York, Boston and Chicago, in addition to the home office in Bucyrus, O.

The National Car Coupler Company, of Chicago, has opened an office at 150 Broadway, New York, and will be represented

by Mr. S. A. Stevenson. This is found necessary on account of the increased volume of business in the Hinson coupler, the National steel platform and buffer and the Hinson draw-bar attachment. Mr. Stevenson has had a long railroad experience on the Wabash and other roads, and has a wide acquaintance among railroad men.

The Richmond Locomotive Works have just received an order from the Rio Grande Western Railway for five 23½ and 30 by 28-in. compound consolidation locomotives, the principal dimensions of which are as follows: Drivers, 56 ins. in diameter; total weight, 187,000 lbs.; weight on drivers, 170,000 lbs.; firebox, 122 by 41 ins.; total wheel base, 24 ft. 6 ins.; driving wheel base, 16 ft. 3 ins.; tires, 3½ ft. thick; driving axle journals, 9 by 12 ins.; steam pressume, 185,000 lbs. The tenders will carry 6,000 gallons of water.

The Westinghouse Air Brake Company have received orders for their friction draft gear from the Baltimore & Ohio Railroad for 7,500 new cars, 6,000 of which are now being built by the Pressed Steel Car Company, the other 1,500 being wooden cars ordered from the Pullman Company. They have also received orders for the draft-gear for 5,000 cars for the Pennsylvania Railroad. Orders for 12,500 sets or 25,000 single gears from such roads as these constitute a strong endorsement which requires no comment.

Mr. Jos. H. Williamson, who for nearly eighteen years has been the business manager of the Manufacturers Advertising Agency, New York City, announces that he has severed his relationship with that company to connect himself with the well-known Viennot Advertising Agency, 524 Walnut street, Philadelphia, as its business manager in the place of Mr. Thompson, resigned. Mr. Williamson will be glad to welcome his friends at the office in Philadelphia, or at the New York office of the Viennot Advertising Agency, 127 Duane street, Graham Building.

To those who are considering the purchase of machinery or any system of mechanical appliances the Philadelphia Bourse offers unusual opportunities in its exhibition department, where facilities are provided for practical demonstrations of the work of machinery in operation. The Bourse, through its exhibition department, is an important machinery trade center and is kept in close touch with progress through inquiries for all classes of machinery. On account of these inquiries for the builders of various classes of machinery, prices, etc., a bureau has been established where such information may at all times be had. The bureau has a free local telephone for the use of exhibitors and in the event of the absence of the exhibitor or his representative messages will be carefully attended to and considered confidential. Thus the Bourse is filling a long-felt want and is doing it in a way which is sure to be appreciated.

Mr. James L. Taylor has been elected Third Vice-President of the Consolidated Railway, Electric Lighting & Equipment Company. He was until recently the General European Agent of the Pennsylvania Railroad in London, and previously had a railroad experience in this country, having served in prominent positions on the lines forming the Plant and Southern Railway Systems, before entering the service of the Pennsylvania. He is well and favorably known in this country as a railroad man, and during his residence abroad attained an enviable position in the social and railway world. He was president of the American Society in London and delegate to the International Railway Congresses in London and Paris. He was connected with the American Commissions at both the Brussels and Paris Expositions, and for his services at the first named he has the decoration of the Order of Leopold. Mr. Taylor's election promises to be a valuable addition to the organization of the Consolidated Company.

The American School of Correspondence, Boston, being situated in a large city which is a recognized educational and industrial center, has many natural advantages in teaching the theory of the trades and engineering professions. Without leaving home or losing time from work, the student pursues a thorough course of study under the direction of able instructors, who are always ready and willing to assist him. Instruction papers, prepared especially for teaching by mail, are furnished free. These papers, written in clear and concise language, as free as possible from technicalities, are much superior to ordinary text-books on the subjects of which they treat. In addition, special information regarding any difficulties in their studies is furnished students without extra charge. It should be the ambition of every man to advance in his trade or profession. A mechanic with practical experience supplemented by theoretical education, can command a better position than a man without such an education. The result of long experience in teaching by mail show that no other method so fully meets the requirements of men who have but little time for study.

NEW SHOPS OF THE LUNKENHEIMER COMPANY.

The new machine shop building which the Lunkenheimer Company has just completed is situated on the block bounded by Tremont, Waverly and Lawnway Streets, Fairmount, Cincinnati. This building is 90 ft. wide by 170 ft. long, with two stories and basement and is built on the usual machine-shop gallery style of construction. There is a traveling crane 30 ft. wide which runs the full length of the building, leaving galleries on the second floor, on both sides, 30 ft. wide. The construction is of steel throughout and designed to safely carry a load of 300 lbs. per square foot. This building was erected for the purpose of taking care of three important departments of the company, viz.: iron valves, injectors and safety valves. It is, strictly speaking, a model machine shop and is equipped

New Machine Shop.—The Lunkenheimer Company.

throughout with the very latest tools and appliances for producing the articles mentioned above. The steam plant consists of a 125-H. P. special Babcock & Wilcox boiler built for a safe working pressure of 400 lbs. per square inch. In connection with this boiler there are a number of appliances for testing devices under steam, air and hydraulic pressure. The building is lighted by electricity and the power is furnished by a 100-H. P. engine. The exterior of the building presents a very handsome appearance, being pressed brick throughout. The location is an excellent one for manufacturing, railroad facilities are ample, and a track spur from the C. H. & D. railroad leads to one side of the building. The erection of this building will not, in any way, reduce the building now occupied by the company on East Eighth Street, Cincinnati, which will hereafter be entirely devoted to brass work. The company contemplates the erection of a large building on some other property which they own, which is adjacent to the new building, but it is not likely that this will be carried out for another year. By the erection of this new building the manufacturing facilities have been increased about 25 per cent. and employment is given to 100 men in addition to the force already operated, bringing the total force up to 500 hands.